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VOL. XIII. NEW YORK, JUNE 8, 1889. No. 23.

The Medbery Underground System. GREAT interest will, we think, be taken in the article appearing in our pages this week from Mr. H. J. Medbery, who describes some of the features of his underground system. It will be noted that the conduit is made of wood fibre, the recommendations for which, in the manner of its employment as described, seem numerous.

Motor Regulation. NOTWITHSTANDING the numerous methods of motor regulation pointed out by Mr. F. B. Crocker, in his paper read before the American Institute of Electrical Engineers, the discussion thereon brought out several more, some among them being quite novel, if not altogether practical. Even these by no means exhausted the subject, as new combinations of those already known may be easily conceived. Much of the discussion, it will be noted, was confined to the question of sparking in motors and the methods best adopted to avoid it. Prof. Thomson expresses some very clear views on this point, and lays special stress on the value of the carbon brush. According to Prof. Thomson, a brush made of this material acts in two ways to prevent sparking, viz.: First, by its breadth giving the commutator segment and coil under it sufficient time to change the direction of current in it; and, secondly, on account of its comparatively high resistance, which prevents short-circuiting of adjacent commutator segments and thus avoids the spark of the extra current. These are evidently valuable properties. While these brushes may find little use on dynamos, in which the sparking may now be said to be entirely overcome, their use on railway motors where speed and current are subject to violent changes, with consequent disturbance of magnetic equilibrium in the machines, would appear to be eminently correct.

Electrical Inspectorships. MR. DE LAND makes a good suggestion in the short article we publish this week as to the need of a frequent and general inspection of electric light stations. While station managers and superintendents are, to our personal experience and knowledge, most wishful of learning how to operate their plants to the greatest advantage and economy, they often lack the requisite training, and even when familiar with the main principles they are wanting in a mastery of the details and refinements the introduction of which makes the difference between running a station at a profit or at a loss. These little "pointers" might so easily be given them by an inspector, that it is a pity they cannot be furnished with the opportunity to benefit by his advice. Moreover, when a station is badly run, it is not a good advertisement for the system in use. We have heard of plants that served as "terrible examples," which the representatives of other systems would sometimes take intending purchasers to see as a warning of what would happen if they bought that particular variety of inferior apparatus. There is some of this inspection, but there will never be enough of it. Next to the visit of an inspector, in usefulness, comes the visit which the station manager himself ought to make to the electric light conventions. If he does not elicit the information he is after on the floor of the house, he will get all he wants in the social hours; and he will be given more real, solid and helpful advice at a single convention than he can live up to all the rest of his life.

The National Electric Light Association. ONE or two episodes at the recent Chicago convention of the National Electric Light Association, drew attention to certain points affecting membership in the body and provoked an active constitutional discussion. Great interest continues to be felt in the subject, and we are glad therefore to publish in this issue, as we do by permission, part of a private letter lately addressed by a well-known representative of the "supply" interests in the association to one of its leading officials. We take it as a good sign of the real harmony and sound, common sense existing in the body that this expression of opinion should come from the "supply" side of the question. We are pleased to find it so much in accord with our own views on the subject, and we believe it represents faithfully the sentiments of the vast majority of supply men, no matter what may have been said or done to the contrary. The supply men do not wish to control or to dictate the policy of the association. They are not selfish or short-sighted, but are as anxious as any others to see the association influential and respected as the exponent of the thoughts, feelings and opinions of the local electric light companies of America. Paradoxical though it may seem, it is the desire of the supply men to find themselves in a minority in the association, for it is to their interest to bring together as many electric light men as possible. The moment the association passed into the control or manipulation of any supply interest, its doom would be sealed, and it would lose not only its right to its name but its right to existence. At the present time, when the association is getting into such excellent shape, and giving such promise of good work at the hands of the secretary and the other officers, it would be worse than folly to place the body in such a position that its legitimate members could be overruled in their deliberate wishes and intentions, and made to appear before the public as approving policies that they dislike or condemn.

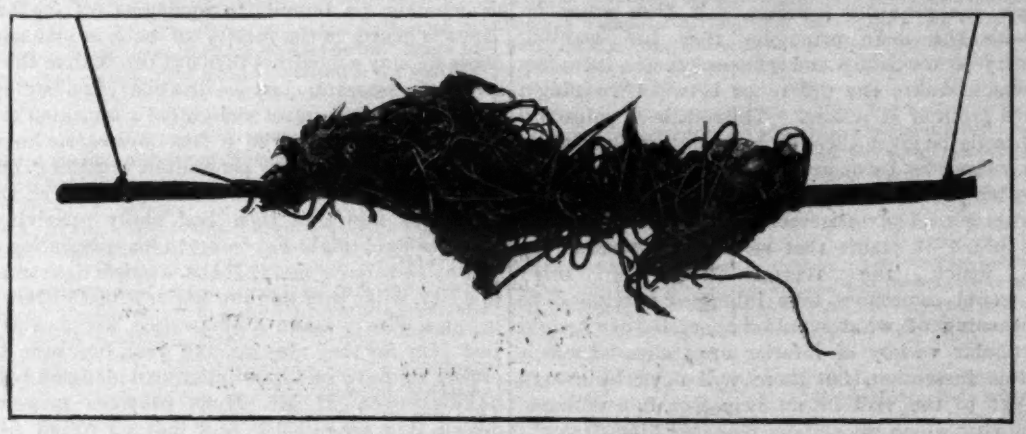
Throwing Out the Tickers. IT is safe to assume that nothing but a belief that the crisis was grave and serious could have induced the Governing Committee of the New York Stock Exchange to take its sensational action last week of throwing out the tickers. Since the ticker companies must supply the bucket shops with quotations if they supplied anybody, the remedy seemed to lie in striking right at the root and in silencing the tickers, so that nobody got quotations; and this was the heroic and radical method adopted. It now remains to be seen how the policy will answer. Of course the bucket shops are badly hit, and thus far one point is gained. It is estimated that there are 4,000 or 5,000 bucket shops in the country, and that they often trade in over 1,000,000 shares a day, or as many as the New York Stock Exchange will trade in during a whole week. Moreover, as the bucket shops represent a "short" interest they not only demoralize their customers, but affect finance and commerce very injuriously by being "bearish" and pessimistic as a matter of necessity. Now, however, the Stock Exchange will be relieved of this double drag, and should recover its business, having a market more subject to the normal conditions of demand and supply, and more fairly expressive of the convictions of the investor. The Consolidated Exchange, a large and important organization, remains, and is already making its own quotations; but it does not strike us as desirable or likely that two authorities can go on independently, each making quotations. There can after all be but one proper price at any instant for any stock, and that price must be made in one place. Still, the action of the Stock Exchange goes to extremes and may, after all, be regretted by the members. It is true they deprive others of the quotations, but they are also depriving themselves, and no resort to primitive "pushing the pad" and messenger service will meet the requirements of the case. The situation is interesting, and the next two or three weeks will have interesting developments. But the ticker will tick again.

Mayor Grant's Leniency. THOSE who have to meet Mayor Grant must be in a delightful state of uncertainty as to whether he is going to insult them again or whether he intends to apologize for the last insult. There is charm in the society of such a man as that, because he may sometimes turn out better than the occasion seems to warrant; just as the converted Saul of Tarsus must have been a most delightful companion to some of the poor Christians, who a few days before knew of him only as a blood-thirsty persecutor, breathing out threatnings and slaughter. We dare say, however, that those Christians now and then had chilly misgivings as to whether Paul might not revert to his persecuting rôle, and so we can believe, too, that the electric light managers of this city, when they find the Mayor actually allowing them to run a wire or make a connection, are puzzled to know just how far they may go, and just how soon they may expect to have another indictment dangled before their anxious eyes. If Mr. Hyde proposes to remain Dr. Jekyll, they are satisfied, and will go ahead peacefully, but they do not want to get started and then find that their property is all to be chopped down with an almost malignant glee by somebody armed with brief authority and a sharp axe. It is said that Mayor Grant has ambitions for the governorship of the State. If that be so, probably the electric light companies might be easily induced at once to help gratify him, for the sake of peace, by getting him out of the city, and to show the public how really high and noble Mr. Grant's aims are.

Electric Railway Operating Expenses. WHEN the managers of street car lines are approached by the promoters of electric railways, their first question is the logical one, "What will it cost?" And among engineers generally the cost of operation of electric railways is still a question upon which few definite figures as a basis of calculation have been available. It is true that reports from all over the country confirm the economy of the system, and so leave no doubt as to its value and the ultimate position which it will occupy as a system of transportation; but exact figures on the subject cannot fail to hasten the work which is now so well begun. To all interested in the operation of electric railways, therefore, the test of the Daft Asbury Park road, made by Mr. F. E. Idell, M. E., which we reprint from that excellent journal, *The Stevens Indicator*, will be of more than ordinary value, being probably the first reliable test of the kind made in this country. From these data we gather that at the place named the cost of motive power for operating 14 cars, 17 to 18 hours per day, is $3.13 per car, which could, of course, be considerably reduced with an increased number of cars. As against $5.50 to $6, which would be required for operation by horses, the economy of the electrical system is apparent. Favorable as the showing here made is, it might be claimed that it could have been even a better one, on account of the somewhat high consumption of coal per horse-power per hour, which would naturally be attributed to the engines. But on second consideration the reason for this will be more apparent, and the cause thereof cannot be ascribed to the engines as machines of low economy, for several reasons. In the first place the engines were continually running under widely fluctuating loads, due to the peculiar nature of street-car service and for the most part under half load. In addition to this the steam piping was large enough to supply double the number of horse-power of engines that are now in use in Asbury Park, and was, besides, uncovered. Again, the coal used in banking the fires on both nights of the test was counted in the final result and no allowance was made for the unburnt coal which fell through the grates or which remained on the grates at the end of the test, all the latter being considered as ash. To all this must be added the fact that no allowance was made for the steam condensed in the pipes between the boiler and engine, and that the grates were cleaned before and after the test; and all coal thrown into the furnace, together with the equivalent of wood used for starting the fires, was charged against the engines. When engines are tested for their guarantee requirements these items are all taken into consideration, and if allowance be made for them it will be apparent that the true economy of the engines would be considerably greater than that indicated by the gross coal consumption of 5.9 pounds per horse-power hour. It will be noted that Mr. Idell's attention was mainly directed to ascertaining the amount and cost of power required, and that his investigation did not include any electrical measurements, being confined entirely between the limits of the coal-pile and the engine. We shall shortly supplement this valuable investigation by another made on a Western road, in which the electrical measurements have been taken into account and the economy of an electric railway system from the engine to the motor on the car has been specially considered.

A "Fault" in an Ocean Cable.

The value of laying ocean cables containing two cores was shown during the violent storm of Nov. 25, 1888, when a fishing schooner about 26 miles from Gloucester, Mass., dragged her anchor for some distance until at last she hooked the Rockport cable of the Commercial Cable Company's system, riding to it for about 48 hours and producing the fault shown in the illustration. It was found when picking up the cable during the repair, that she had dragged along it for some 400 yards, tearing off



A "FAULT" IN AN OCEAN CABLE.

the outer covering of jute and compound, also one of the armor wires, rolling it up into a tangled mass and at last driving the end of the steel armor wire between the sheathing of the cable and through one of the cores but leaving the other absolutely intact. With a single core cable of the ordinary type, communication would have been interrupted until repairs were effected; but in this case, by means of the uninjured core, traffic was passing continuously with the exception of a few hours, during which the repair steamer had the cable cut in order to remove the fault. Considering the extreme violence of the gale and the large size of the vessel, it is surprising that the cable did not part, and the incident speaks well for the mechanical strength of the Commercial Cable Company's cables.

The repair was made by the steamship "Pouyer-Quertier," which was chartered for the purpose, as she was the only available cable steamer on this side of the Atlantic. Capt. S. Fossard, who commanded the steamer, showed such great skill in manœuvring her that although two and a half miles of cable was picked up and relaid across a tideway of four knots per hour, it was found, on completion of the repair, that the cable was only lengthened by a few yards.

The electrical department on board was in charge of Mr. Chas. Cuttriss, the company's electrician.

This remarkable "fault" has now been placed on exhibition at the Paris Exposition by the Commercial Cable Company, who also exhibit there the Cuttriss recorder, and types of cables showing damage by ice, etc.

The Medbery Underground System.

BY H. J. MEDBERY.

Undoubtedly the most serious problem that is agitating the minds of electricians at the present time is that of laying electric light and power distribution wires underground in a safe, economical and durable manner.

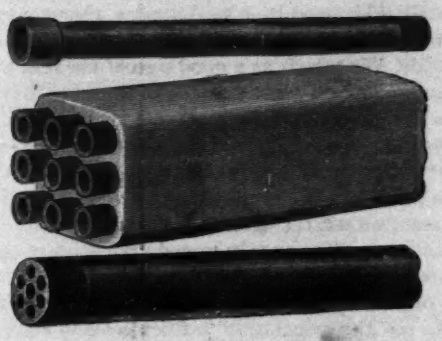
Many systems and plans have been devised to accomplish this result, and while many of them are meritorious and deserving of attention, nothing has been found that successfully accomplishes the desired results. The chief difficulty has been the inability to guard the wires properly from contact with the conduit or from gases and moisture. It has also been found difficult to provide a system that will protect human life without great and expensive outlay. An ideal system, moreover, must combine extreme durability with ease of laying and distributing for house and street lighting and power.

The patented system which I now desire to call attention to consists of one or more tubes made from wood fibre and treated with a chemical compound which renders it water and fire proof. The material is not subject to deterioration by the action of acids or gases, but is of great strength, practically indestructible, and not subject to decay when placed underground. The sections are joined by threads cut in the pipe, like iron pipe, and with a sleeve coupling. At the manholes the pipes do not terminate as in other subways, but continue directly through with a collar which can be unscrewed when necessary to reach the cables or wires. Hence gases and moisture cannot get into the pipes. For all underground wires this advantage is of great value, as explosions cannot occur as they have done with existing methods and material. This system is especially desirable for telegraph and telephone wires and is highly commended by several of the largest corporations in the country.

The conduit for light and power wires and system of distribution, which is shown in perspective in Figs. 1, 2 and 3, combines several new and valuable features, which will be promptly recognized by all interested. Each "conduit" is divided into four or more compartments, made of a perfect insulating material, and the wires occupy separate ducts, which precludes the possibility of "cross arcs"; and in the event of a "misplaced switch" at the station, and the "positive" current being turned into the "negative" conduit, no harm nor damage can ensue.

The question of the cost of properly insulating wires is one of considerable importance. The expenditure is necessarily very great in the ordinary method of laying wires; but in this conduit, by reason of its high insulating qualities, expensive insulation of wires is avoided.

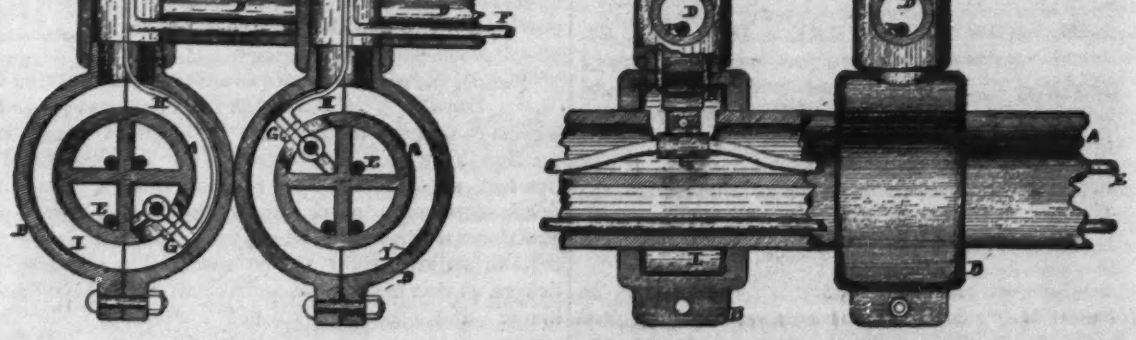
Another noteworthy feature of this system is the method of distributing to houses and street lamps. Usually it is necessary to make provision for this when laying the conduit, which is necessarily very expensive; but by this system side taps and connections can be as easily made *at any time* after the conduit is laid, and without serious ex-



FIGS. 1, 2 AND 3.—THE MEDBERY UNDERGROUND SYSTEM.

pense, as I will explain from the accompanying illustrations, Figs. 4 and 5.

When desiring to make connection with the main line, the conduit is exposed at any point, and an opening is cut in it in any preferred manner. It is usually drilled. The wire is then lifted from its resting place in the conduit, through the hole in the conduit, and the two parts of the metallic clamp *G* being first separated are put over the wire and firmly attached thereto by means of a screw. The clamp has a chamber into which a suitable metal or solder is melted or fused, making a perfect contact and permanent joint. The two sides of the casing or connecting box (which, it will be seen, has a recess or hollow interior) may be filled with suitable insulating cement while in a plastic state, and they are then placed about the conduit in such a manner that the extension of the clamp, *H*, projects through the neck of the casing as shown in the cut. The bolts are then inserted in the lips of distributing duct *B*, and screwed up. The cap *C* is then applied and forced firmly down upon the tapering neck of the casing, after being properly cemented. The branch wire is then connected with the extension from the clamp *H*, and when it has been passed through the first length of the branch conduit *F*, the branch conduit is screwed into the threaded hole in the side of the cap *C*, or preferably cemented into place. The branch line can thus be extended as far as may be desired. Thus far in the process connection has been made with one wire only, either the negative or the positive wire, but, of course, the connection with the other wire will be made in a similar manner.



FIGS. 4 AND 5.—THE MEDBERY UNDERGROUND SYSTEM.

After both connections are made and all parts are secured in place, I inclose the entire device in a mass or ball of hydraulic cement, as indicated in Fig. 2, which will solidify and protect the parts from accident or injury from tools of workmen in subsequent excavations.

The advantages of this system over any other are apparent, as the main conduit can be opened at any time and connection made in a very easy, expeditious and inexpensive manner, and is not restricted to any defined place, as under the old method. This is a matter of great importance in cities where gas, sewer, water and other pipes or conduits frequently interfere with, if not preclude, access to the conduit at the points where the connection boxes should happen to be located.

The system as above outlined is being introduced by the American Indurated Fibre Company, of Mechanicville, N. Y., from whom further information may be obtained. I may mention that satisfactory practical work with it has been done by the Bell Telephone Company, of Philadelphia; the Pennsylvania Railroad Company, and other parties.

General Inspectors of Electric Plants.

BY FRED DE LAND.

After visiting several hundred local lighting stations in the smaller towns and noting the many imperfections—some small, some large—existing in station or line circuit, the absence of good workmanship and the lack of economy apparent in the construction and maintenance of circuits, the imperative need of the services of a competent general inspector is plainly evident, and it is a matter of surprise and of comment that such an office has not been established by the leading manufacturing companies.

That the local lighting companies would heartily approve of such a step and encourage its continuance is beyond all doubt, and there are plants where a fair charge or fee would gladly be paid if deficiencies were pointed out or practical improvements suggested.

But laying aside all thought of fees, the maintenance of such an office should not exceed a yearly outlay of $5,000, and the five prominent companies could well afford to appropriate that sum yearly, as close inspection would certainly lead to improved service, and also to increased sales through the cultivation of a feeling of hearty good will towards the parent company, that would be invaluable in establishing new stations.

The office should be filled by a thoroughly practical man of good address, accustomed to traveling and meeting all classes of men, and honest and thorough in examining every detail. He should be thoroughly conversant with all the details of the apparatus, both old and new, manufactured by his company, and able to explain its operation in simple language; to practically illustrate his remarks, more especially in the adjustment of coils and springs and delicate mechanism.

He should be thoroughly competent to observe the economical working of engine and boiler and to suggest improvements and correct defects therein; be able to quickly estimate the theoretical and actual value of the fuel consumed, and if the fuel account exceeds an average sum should be able to trace out the cause and suggest a remedy, whether it be in the changing of fuel, the removal of soot or cleaning of tubes, or a change in the method of firing.

He should be able and willing and prepared to quickly climb a pole, and show how to take in the slack wire and to secure it more strongly to the insulator; to determine if the length of the circuit could be economically reduced, and if the setting of a higher pole at a certain point to raise the line above the foliage would save fuel during heavy storms. "Economy in maintenance" should be his watchword, yet he should be careful to see that it is not overdone, and by the employment of cheap labor securing only cheap service to the disgust of patrons.

And above all he should be so loyal and true to the system he represents and so enthusiastic over its merits that he will infuse all whom he meets with some of his spirit,

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and he should especially endeavor to dispel any dislike to the system existing in the minds of local customers, and also aid in increasing the number of patrons if his limited stay in the town will permit.

It may be claimed that the duties outlined belong to and are carried out by the local superintendent and his engineer. That may all be true, but in the majority of small towns the superintendent will be the first to welcome the inspector cordially. In any case the visit of a live, energetic, competent representative will do no harm, and in the majority of cases will prove a blessing.

The Westinghouse System Abroad.

Mr. Westinghouse has commenced proceedings in France, says the London *Electrical Engineer*, where he is about to form a company with a capital of one million sterling. The company is to erect and fit up a number of works for the manufacture of plants (steam engines, dynamos, transformers, meters, lamps, etc.) for supply to central stations. It also proposes to compete for the lighting of the Parc Monceau, the Champs-Elysées and a section of the left bank of the Seine. A well-informed Yank, who professes to know all about it, says that Westinghouse is also awaiting the result of the Board of Trade inquiry, not that he hopes much from it, but it may make matters more difficult for him, and therefore give him a chance of showing what America can do when she is put to it.

Measuring High Potentials.

To the Editor of The Electrical World:

SIR: The method of measuring high potentials by means of incandescent lamps connected as a shunt to a dynamo, which was described by Mr. Perry in your issues of April 6 and May 25 of this year, is not new. It was used here a year ago by some of our engineering students in conducting quite an extended test on the Thomson-Houston machines of the city electric light station. The method was suggested to us by Mr. Lockwood of Detroit. By means of 20 Edison lamps and a Thomson voltmeter, a measurement of voltage as high as 2,500 could be taken in a few seconds, after the whole series of lamps had been gone through a sufficient number of times in sections, so as to determine the relation of one section to the entire series. So long as the same lamps remained in series it was only necessary to take a reading on one section in order to find the potential difference between the terminals of the entire series.

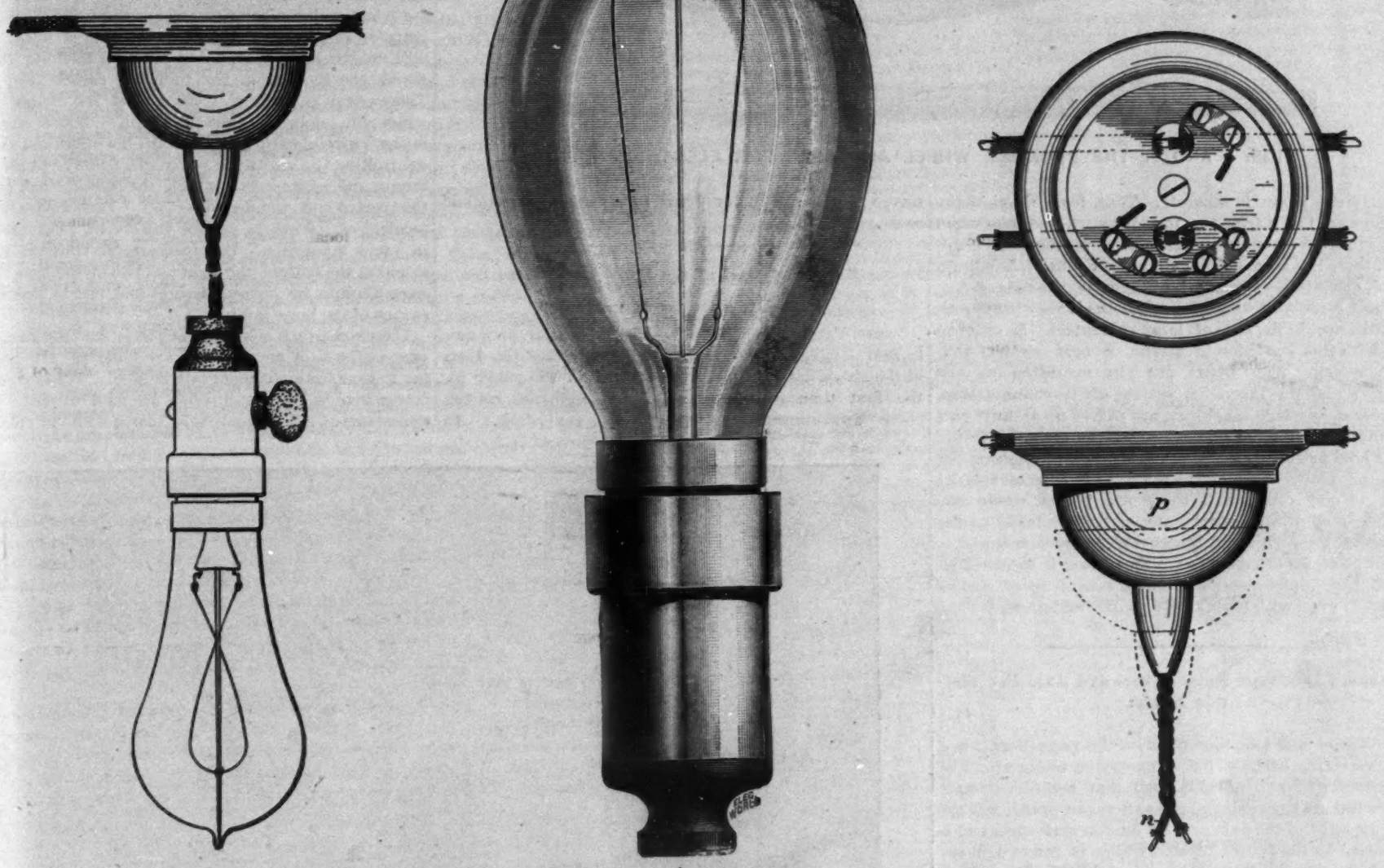
It is quite probable that the accuracy obtained in this way is greater than would be secured by going over the entire series every time a measurement is taken, because of the changes in E. M. F., which take place during the several minutes required to take readings for the several sections.

H. S. CARHART.

UNIVERSITY OF MICHIGAN, ANN ARBOR.

The Backstrom Incandescent Lamp and Ceiling Cut-Out.

With the constant tendency toward increasing the resistance, and hence the fineness, of the filament in the incandescent lamp, an accompanying drawback is developed that manifests itself in the necessary thinness and weakness of the filament, which not infrequently tends to droop and finally touches the sides of the glass globe. In order to overcome this defect, Mr. Ch. A. Backstrom, the electrician of the Backstrom Electric Light Company, of this city, has designed, and is now making, incandescent lamps of the form shown in the accompanying engraving, Fig. 1. Here, it will be seen, the filament is supported by a slender rod, held rigidly in the glass stem at the top of the lamp and extending to the tip of the globe. This rod has an eyelet through which the filament passes, and which maintains it firmly in position.



FIGS. 1, 2, 3 AND 4.—THE BACKSTROM INCANDESCENT LAMP AND ATTACHMENTS.

The filaments of the Backstrom lamp consist of carbonized silk thread, and are not further treated after carbonization. When lamps of higher candle-power than usually employed are desired a number of filaments are inserted within the same globe, and all threaded through the supporting rod at the loops. Thus, in case of the rupture of one of the filaments, the remainder are still available for maintaining the light. The Backstrom 16 c. p. lamps consume 49 watts, or a trifle over 3 watts per candle.

In connection with a pendant lamp and flexible cord, Mr. Backstrom has designed a very simple ceiling cut-out. This consists of a base board, which is screwed to the ceiling, and upon which are mounted the usual fusible strips, contacts, etc. The whole is covered by a bood *p*, which is maintained in place by a short friction tube that binds snugly against the flexible cord. Thus by merely sliding the tube down, the cover can be removed from the cut-out, so that all the parts can be readily inspected. This arrangement, Figs. 2, 3 and 4, avoids the use of screws, which are frequently an annoyance when the cut-out is to be examined.

Telephone Trunk Lines in Germany.

At the end of 1888 the number of telephone trunk wires in Germany amounted to 166, having a total length of 10,607 kilometres, and over which a daily average of 28,099 messages were sent. The longest line is that between Berlin and Breslau, which attains a length of 348 kilometres, and over which some 100 messages pass every day. The Hamburg-Lübeck line is the busiest, having a daily average of 390 conversations, the Bremen-Bremerhaven wire coming next with 276 conversations per diem. The authorities have decided to erect 12 additional trunk lines during the current year.

A Comparison of the Mercury Unit with the B. A. Unit of Resistance.

The last number of the Johns Hopkins *University Circulars*, No. 73, contains a very interesting account of a recent research by Messrs. Cary T. Hutchinson and Gilbert Wilkes.

The object of this research, which was conducted in the Physical Laboratory of the Johns Hopkins University, under the supervision of Prof. Henry A. Rowland, was the determination of the ratio of the resistance, at 0° *C.*, of a column of mercury, 1 metre long and 1 square millimetre in cross section, to the British Association unit of electrical resistance.

The method employed in making the observations was, with slight modifications, the same as that used by Lord Rayleigh, by Glazebrook and Fitzpatrick, and also in a similar determination already made at the Johns Hopkins laboratory.

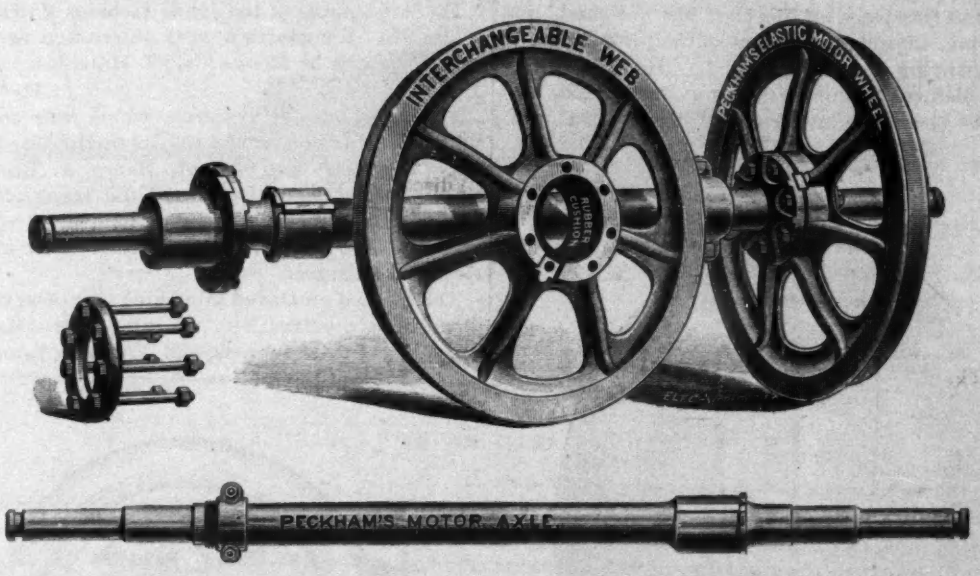
The resistance at 0° *C.* of a column of mercury, filling a fine, accurately calibrated glass tube, was determined in British Association units; the length L was known; its mean cross section at 0° *C.* was found by weighing the volume of mercury, contained at that temperature, and dividing this by L, multiplied by the density of mercury (ρ) in grammes per cubic centimeter.

The value in B. A. units of the resistance of a column of mercury one metre long, one square millimetre in cross section, at 0° *C.*, was found to be 0.95341 ohm. This compares very favorably with the results of previous investigators, which are given in the table below:

Observers.	Date.	References.	Value of 1 metre of Mercury in B. A. U.
Lord Rayleigh & Mrs. Sidgwick.	1883	*Phil. Trans.*, 1883.	.95412
Mascart, Nerville and Benoit...	1884	*Journal de Physique*, 1884.	.95374
Strecker.....	1885	*Wiedemann Annalen*, vol. 25, 1885.	.95334
L. Lorentz.....	1885	Same.	.95388
Rowland.....	1887	Communicated to British Association, 1887.	.95349
Kohlrausch.....	1887	*Abhandl. der K. Bayer. Akad. der Wissenschaften*, II. classe, vol. 16, Abth. III.	.95331
Glazebrook & Fitzpatrick.....	1888	*Phil. Trans.*, 1888.	.95352
Hutchinson and Wilkes.....	1888		.95341

The Electric Road at the Thomson-Houston Factory.

All who have had occasion to visit the huge works of the Thomson-Houston Electric Company at Lynn Mass., will remember that they cover an immense area, the various departments being quite distinct. The machine work is done in one part, while the winding of the different pieces is done elsewhere. The storehouse is quite remote from the point where the machines, etc., are finished, and the packing and shipping department again is separate. Thus, from the time the castings are taken from the foundry until the time when the completed apparatus is taken away on the steam railroad, there is a large and inevitable amount of handling, which constitu tes an important item in the cost of production, especially where the apparatus is very heavy, as, for instance, in the case of large generators. In order to deal with this condition of affairs, a neat electric railway system has been put in operation at the factory. By an ingenious system of traveling cranes, the pieces, or whole machines, are picked up at any part of the factory and put on a car, when the motor comes up, takes hold and hauls them promptly to the destination. There are places at which the motor ascends grades of at least 12 per cent., and there are points where the flexible trolley arm lowers automatically almost to the horizontal line, while at others the conductors run at a height of not less than 20 feet. The motor is intended to run slowly, but if necessary a high rate of speed can be attained, even with loads of 800 pounds and more.



FIGS. 1 AND 2.—THE PECKHAM WHEEL AND AXLE FOR ELECTRIC CARS.

Peckham's Improved Motor Wheel and Axle For Electric Roads.

The wheel and axle illustrated on this page (Figs. 1 and 2) are especially designed for use on electric motor cars. The construction of this wheel is such that metallic contact between the wheel-web and the axle is prevented, and the entire weight of the axle and its burden rests upon and is supported by the rubber cushion which is inserted in the eye of the wheel between the web and hub. The plan of thus supporting the entire weight of the load on the rubber cushion, relieves the axle and the motors resting upon them of jars and concussions and consequent crystallization produced thereby, besides preventing noise and giving an easier-riding car.

The hub of the wheel is made of steel, and forced by hydraulic pressure upon the axle, where it remains until the axle is broken or worn out. The web portion of the wheel is made of the best charcoal iron, and secured upon the wheel-hub by bolts which can be easily removed when the web is worn out and a new one placed upon the hub at any car stable, and by any ordinary workman.

The wheel-hub is slightly tapered to correspond with the taper of the rubber cushion which fits snugly into the web, and is secured in place between the web and hub by malleable iron front-plates. All parts of the wheel are made to templets so that they are strictly interchangeable.

The axle shown in connection with this wheel is also especially designed for motors. It is constructed with an enlarged bearing for the split-gears in general use on motor cars, so that the key-seat for the key used to prevent the split-gear from turning upon the axle is cut into the enlarged bearing instead of (as is customary) in the axle proper; and while giving an increased bearing for the gear, the increased bearing also affords a shoulder for the motor bearing to keep it in place. The axle is also provided at the opposite end with a screw-threaded adjustable collar, which can be moved at will, and the motor bearings kept in their proper place, all lost motion being properly adjusted. These axles are made of the best hammered iron and steel, as preferred.

The Peckham horse-car wheels, constructed upon the same principle as this wheel (but not as heavy and strong), have been in use on horse cars for over two years and are heartily indorsed by all who have used them. The Peckham motor wheels (as shown in the accompanysing cut) are being used by all of the leading electric motor ,manufacturers, who realize the importance of such a wheel for motor cars. They are in use by the Thomson-Houston and Sprague companies, and the Bentley-Knight Company are using them in Boston, besides having now ordered them for new roads at Port Chester, N. Y., and Lowell, Mass.

The Peckham Street Car and Axle Company, of this city, are the sole manufacturers of these wheels and axles.

Machinery Hall at the Paris Exposition.

[FROM OUR SPECIAL CORRESPONDENT.]

PARIS, France, May 21, 1889.—The exposition may now be said to have fairly started. On Saturday last the doors of the Palais des Machines were opened to the public for the first time in the evening, and immense crowds come swarming in as soon as it gets dark. In fact, so many people are brought here by the many attractions, that theatre managers all over the city have already commenced to bitterly bewail the fact that their income is being greatly curtailed, and they demand that the exposition be closed in the evening or at least for three evenings of the week. It is possible this may be granted. As one enters Machinery Hall, the largest building of its character ever erected, the eye is attracted by an object at once grand and artistic, namely, a huge model of an incandescent lamp 40 feet in height. This is in the Edison section, which covers nine thousand square feet of floor space, there being a special phonograph pavilion in the industrial section in addition to that in the Palais des Machines. These figures may not seem so large, considering the total floor space in the Exhibition, but when it is considered that there is a fifty foot frontage on main aisle, with frontages on four other aisles, and that this space covers nearly one-third of the United States space in Machinery Hall (exclusive of the gallery) some idea of the magnitude of this individual exhibit can be arrived at.

On the main aisle, in one corner of the space, is the large lamp before referred to, mounted on a pedestal, the base of which is twenty feet square, covered with cloth artistically draped. On one side is a large American shield made of red, white and blue incandescent lamps; opposite are the French coat of arms, while on the front are two large flags, French and American, with "EDISON" above, and "1889" below, in opalescent electric lamps. From the top of this base rise a dozen steps made of varicolored lamps, and this bank of lamps ends in the top of the pedestal, which is also square. In the front is a niche surrounded by tiny Edison lamps, with hidden colored lamps on the inside, throwing their light upon a bust of Mr. Edison, which is an excellent likeness of the great inventor.

On the side fronting the main entrance is the monogram "U. S." in opal and blue lamps against a dark background, opposite being the initials "R. F." (Republique Française) in red and white, while on the back is a large five-pointed star made of ground glass globes. The lamp and socket are perfect models of the standard Edison lamp and socket magnified twenty thousand times. The lamp is composed of 20,000 perfect 16 c. p. lamps, which will not be lit, however, but act as a medium through which the light from the immense carbon may shine. This carbon is made of 6,000 c. p. of red lamps, which, when lit, emit a beautiful light. Inside the base is the switch-board, on which the switches and cut-outs controlling the multitude of circuits running to the many lamps, and by means of which the operator can produce the varied and wonderful effects. Each device is independent of the others, yet one can be lit after the other in rapid succession. For instance, starting at the big shield at the bottom, the light can run up the base, step by step, illumine the various designs and end by lighting the carbon of the large lamp.

The phonograph is at present placed on the main aisle, where crowds of eager visitors are standing all day waiting to hear the instrument talk or sing. It has created a furore here in Paris, and people are wild to make its acquaintance. All around this instrument in this front space are handsome tables mounted with various telegraphic apparatus, the different systems which Mr. Edison has brought out being represented here in working models. These instruments include the quadruplex, phonoplex, new stock telegraph, printing telegraph, automatic telegraph and perforator, duplex and harmonic telegraphs, train or "grasshopper" telegraph, and chemical, Gold & Stock, and autographic telegraph apparatus. The space is divided from the adjoining one, devoted to physical apparatus, by a zig zag boundary or fence made of beautiful water-color charts 3 feet high by 5 feet long in broad oak frames. At each angle of this fence is a 100 c. p. colored lamp. On the side fronting the telegraph instruments are the charts descriptive of the various telegraphic apparatus, while on the opposite side are charts illustrative of the physical

THE ELECTRIC ROAD AT THE THOMSON-HOUSTON FACTORY, LYNN, MASS.

apparatus here exhibited. Among other instruments are several pieces of apparatus illustrating what Mr. Edison calls his "motograph principle," voltmeters and indicators, galvanometers, webermeters, historical meters, pyromagnetic motor and generator, vote recorder, water bridge, etheroscope, odoroscope, magnetic bridge, electric pen, tasimeter, megaphone, vocal engine, and many others. In this space is also a "Thorne" combined type setting and distributing machine, at which the operator sits, receiving dictation from a phonograph, the matter thus set up being printed on the spot by a printing press run by electric motor. This is done with great facility and shows another of the many uses to which the Edison phonograph may be applied. The space on the other side of the aisle is devoted to electric light machinery and the Edison underground

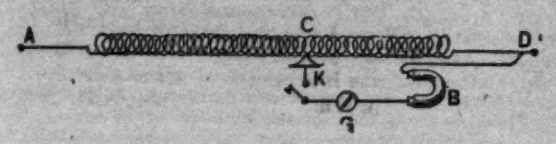


FIG. 1.—THE RELATION BETWEEN THE INITIAL AND AVERAGE EFFICIENCY OF INCANDESCENT LAMPS.

system of conductors. Here is to be seen a sectional view of Edison tubes laid in place and connected, the exhibit comprising feeders, mains, taps, junction or distributing boxes, and the various kinds and sizes of tubes used in a genuine central station system. The process of manufacture of these tubes is also clearly illustrated. The dynamo plant installed here comprises a complete three-wire Edison system run from two 500-light machines; also, a No. 56 dynamo having a capacity of 2,500 lights, running the two-wire isolated plant department; also, a 1,200 volt municipal dynamo running the 100 municipal lamps surrounding the entire exhibit. These machines receive their power from a line of shafting overhead, run from the engine of C. H. Brown & Co., of Fitchburg, Mass., which is here in the American section. This main shaft is belted to a counter shaft directly underneath, to which the dynamos are connected. The shafting is inclosed by a four-walled partition twelve feet high, which forms a very convenient stock-room. The wall nearest the dynamos is used for a switch-board, and is covered with a rich colored cloth, on which are mounted the ampère-meters, pressure indicators, regulators, dynamo and feeder-equalizer switches, and the various copper rods and multiple safety catches necessary. By means of the arrangement of switches the three-wire system can be made into a two wire system, or the isolated plant can be used as an auxiliary to the central station plant. Going around the partition, the model central station meter room, where the working of the Edison meter system is most graphically represented, is seen. Here also the magnetic ore separator is in operation, showing how readily the iron particles in the crushed ore can be separated from the worthless stuff. On the wall is the large oil painting of "Menlo Park, The Birthplace of the Incandescent Light," in the early evening. The sun has just set, and the grounds and buildings are covered with snow. In the foreground is the old Edison laboratory, with the workshop, forge, office, etc., while on the right the electric railroad runs off into the woods. From the midst of the group of buildings rises the ghost of an Edison lamp, whose rays, extending to all sides, open at the extremities into medallions of some well-known buildings in the different countries of the world illuminated by the Edison light. Here is also a chart representing, graphically, the growth of the electric light industry in the United States during the last ten years. In this space are a number of cases containing specimens of lamps, fibres, &c., explanatory of the various stages in the manufacture of the incandescent lamp. On the extreme rear space is the telephone exhibit devoted to ancient, historical and modern telephone apparatus, and here are also the Edison headquarters in a handsome building beautifully draped and decorated. It is used as an office, and contains also a handsome grand piano and special telephonic and phonographic apparatus. Experiments will here be tried on long distance phonograph transmission; special cylinders will also be made here. It is intended that this shall be the headquarters of any of the electrical fraternity who reach this side of the water, and to whom a hearty invitation is extended to call.

The Special Phonograph Pavilion in the Industrial section is a beautiful building, made of iron and glass, very well adapted to the accommodation of a large crowd of visitors, each of whom will be able to hear the phonograph talk in his native tongue, as there is a department devoted to nearly all languages of the civilized world. Mr. Edison has certainly done himself great credit in the display he has made here at the Exposition, and his manifold inventions are displayed in a remarkably interesting and instructive manner.

E. W. H.

The Relation between the Initial and Average Efficiency of Incandescent Electric Lamps.*

BY WM. H. PEIRCE.

At the present day there is very little reliable published information relative to the variation with age of the economy and light-giving power of incandescent lamps. However well this law of variation may be known to lamp experts, the author believes himself to be justified in saying that the majority of electrical engineers are entirely unacquainted with it. The most complete data, and the latest, at least in this country, is that given in a report in 1885 to the Franklin Institute by a committee appointed to test lamps and dynamos. At that time the successful commercial lamp was but two or three years old, and since then the development of lighting by incandescence has been so remarkable as to cause this lamp test to be now almost ancient history. When considering the possibilities of incandescent lighting in depots, offices and shops, the fact of the absence of trustworthy records of late date induced the following investigation to be made by the author in the interest of the Chicago, Burlington & Quincy Railroad Company.

There were in all 94 lamps studied, embracing four of the most prominent makes of lamps now on the market. Fifty-nine of these were purchased—15 of 3 kinds and 14 of one type of lamp. Care was exercised to obtain the commercial lamp. After the preliminary measurements had been made upon these 59 lamps, the local agents for them were invited to make examination of the test room and of the methods pursued. As an outcome of their visits the remaining 35 lamps were upon their solicitation tested. These lamps were in every case sent direct from their respective factories especially for this test, which fact I am rather prone to construe as a vote of confidence by the various lamp companies in our system of measurements.

The Howell voltmeter was used for determining the volts in all measurements, and the following is a brief description of its principle. The pressure to be measured is caused to drop through the resistance $A\ D$, Fig. 1, equal to about 4,500 ohms, and a Daniell cell B is so arranged that when the key K is closed the electromotive force between $C\ D$ is opposed by that of the battery, and hence no current passes through the galvanometer C, when the electromotive force between C and D is equal to that of the cell. In practice the rider C is moved along the resistance until no current flows through the galvanometer, and the electromotive force between $A\ D$ is then determined from the formula:

$$V = v\frac{R}{r} = 1.08\frac{R}{r}; \text{ where}$$

V = Volts between $A\ D$.
v = Volts between $C\ D$ = electromotive force of cell.
R = Resistance $A\ D$ in ohms.
r = Resistance $C\ D$ in ohms.

Naturally the completed instrument avoids this calculation for each observation by having the rider C move along a scale reading to volts. With the instrument used it was found that when the rider pointed to 110 volts that R = 4493 and r = 44.4, and hence V = 109.3. Similarly, when the instrument read 100 volts, the true reading should have been 99.4, and so when making observations a correction of .6 volt was applied. The electromotive force of the cells was 1.08 volt, as determined at the laboratory of the Edison Lamp Works. The correctness of our voltage indications being thus dependent upon the battery, a standard liable to variation, it was decided to frequently obtain new cells direct from the Lamp Company's laboratory. In the early part of the test considerable care was exercised in comparing the voltmeter with four or five others at hand, and just before starting the duration test four new cells were obtained, and at intervals others were added, as shown by the following table, until ten in all were had. In table No. 1 the cells are numbered from 1 to 10, in the order of their obtainment. Those cells which checked with one another are marked O. K. The last received cells were always assumed to be correct, and

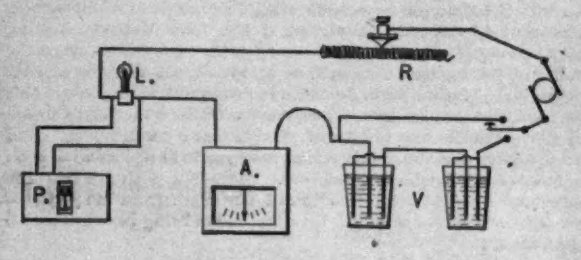


FIG. 2.—THE RELATION BETWEEN THE INITIAL AND AVERAGE EFFICIENCY OF INCANDESCENT LAMPS.

where the old cells differed from them the amount of variation is given in per cent. of the electromotive force of the cell.

TABLE NO. 1.

Cell Number.	Dec. 27, 1888.	Jan. 8, 1889.	Jan. 15.	Jan. 26.	Feb. 11.	Feb. 27.	March 14.	April 1.	April 29.
1..	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	5/8 low	1 1/4 low	1 1/4 low
2..	O. K.	O. K.	Low	Low	Low	Low	5/8 low	5/8 low	1 low
3..	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	1/4 low	1 low	1 low
4..	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	1/4 low	3/4 low	1 low
5..				O. K.	O. K.	O. K.	1/4 low	1/4 low	1/4 low
6..				O. K.	O. K.	O. K.	O. K.	O. K.	O. K.
7..							O. K.	O. K.	O. K.
8..							O. K.	broken	
9..									O. K.
10..									O. K.

In this table it is shown that on Dec. 27 and Jan. 8, all four cells were apparently correct—that is, they check with one another That on Jan. 15, three cells out of four; Jan. 26, Feb. 11, Feb. 27, five of six cells; March 14, three of eight cells; April 1, two of seven cells, and April 29, four of the nine cells were O. K. And further that the maximum variation at any time between any two cells was 1¼ per cent. It is thus seen that we are reasonably assured that our electromotive force was practically constant.

The cells were mounted on a switch-board, so that any two or all of them could be connected in multiple series by inserting plugs, and they were compared with each other by rapidly substituting first one and then another of the cells in the voltmeter while measuring the electromotive force of the test-room circuit. The last two or three cells received were always used when making determinations on lamps.

The ammeter was of the Bergmann solenoid type having a range of from 0.2 to 1.0 ampère. The readings of the instrument were calibrated at the beginning of the test by copper voltameters, the Cu SO_4 solution of which had a specific gravity approximating 1.16, and the area of the cathode was 4 square inches per ampère measured. The coulomb equivalent was taken as .0003288 gr. The arrangement for calibration was as sketched in Fig. 2, where A is the ammeter, a lamp to consume the electrical energy, P a voltmeter, and I adjustable resistance for keeping the pressure uniform at the terminals, as indicated by the voltmeter, and hence to insure constancy of current. The circuit through the voltameters was closed for 15 minutes as timed by a stop watch. Extreme care exercised in preparing the plates and the preventing of between weighings. The following table shows the curre

* A paper read before the American Institute of Electrical Engineers, May 22, 1889.

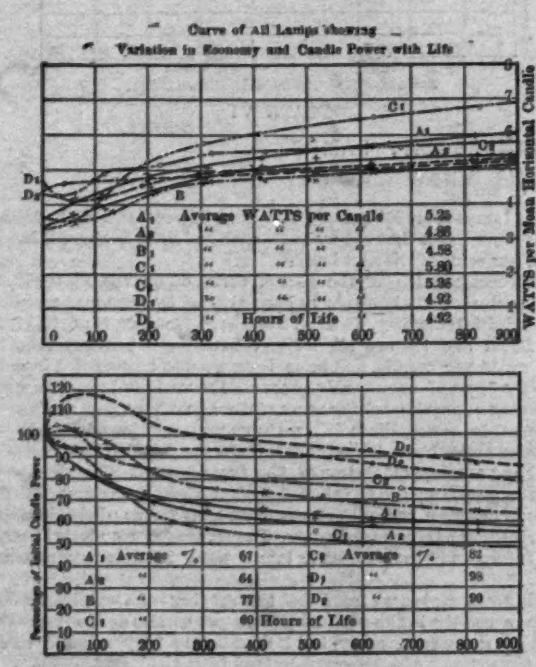

Curve of All Lamps showing Variation in Economy and Candle Power with Life
WATTS per Mean Horizontal Candle
Hours of Life
Average WATTS per Candle
Percentage of Initial Candle Power
Average %

PLATE I

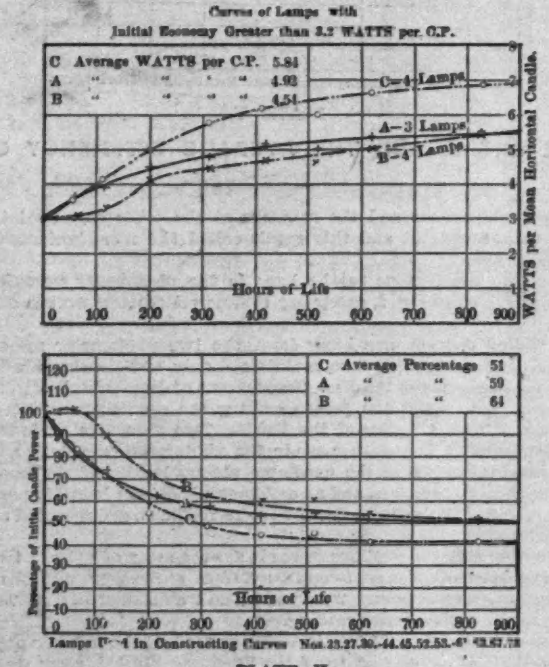

Curves of Lamps with Initial Economy Greater than 3.2 WATTS per C.P.
C Average WATTS per C.P. 5.84
A " " " " 4.92
B " " " " 4.54
C—4 Lamps
A—3 Lamps
B—4 Lamps
WATTS per Mean Horizontal Candle.
Hours of Life
C Average Percentage 51
A " " 59
B " " 64
Percentage of Initial Candle Power

PLATE II

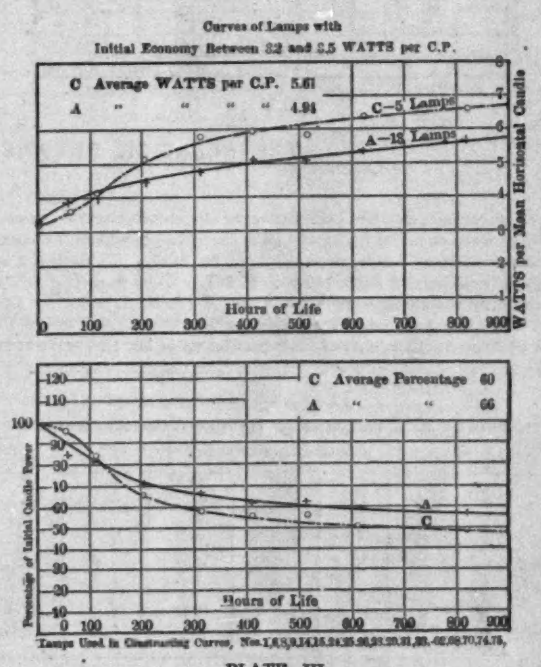

Curves of Lamps with Initial Economy Between 3.2 and 3.5 WATTS per C.P.
C Average WATTS per C.P. 5.61
A " " " " 4.94
C—5 Lamps
A—15 Lamps
WATTS per Mean Horizontal Candle
Hours of Life
C Average Percentage 60
A " " 66
Percentage of Initial Candle Power

PLATE III

ed by the ammeter and that obtained by the voltameters in the last made calibration by copper voltameters.

TABLE NO. 2.

Readings of ammeter.	Readings of voltameters.		Readings of ammeter.	Readings of voltameters.	
.300	.297	.296	.700	.692	.692
.350	.350	.347	.750	.745	....
.400	.399	.398	.800	.791	.796
.450	.450	.451	.850	.844	.840
.500	.493	.493	.900	.898	.894
.550	.549	.545	.950	.947	.948
.600	.588	.588	1.000	.994	.993
.650	.635	.641			

This table shows that the ammeter was calibrated at every .05 of an ampère from .3 to 1.0 ampère, and that the maximum variation between the voltameter and ammeter readings was about .01 ampère, and that generally the two readings checked to within .005 ampère.

After these determinations the scale was changed to such an extent as was estimated would correct the readings of the ammeter.

The photometer was a 60-inch bar, Letheby-Bunsen, in combination with the Methven two-candle slit. The Methven standard was accompanied by a certificate signed by Mr. John Methven, stating that a two-candle power light was emitted through the slit, when the quality of the gas used was such as to give from 15 to 20 candles with a flame 3 inches high. In order to prove the correctness of this standard when using Chicago gas, a comparison with Sugg's standard sperm candles was instituted. Ten different candles were used, two at a time, and the observations were made in accordance with the rules of the London gas referees. Table No. 3 shows that the Methven standard varied less than 1 per cent. from the power of two standard sperm candles; this conclusion being based upon 100 observations.

It was recognized that in a test of this kind the four factors most liable to variation were the voltage, the current readings, the standard of light and the personal errors of the observers. It was considered that the most certain and most practicable way in which to guard against such errors would be to measure the candle power, the voltage and the current upon several lamps, and to put these lamps aside to be used only as reference lamps. Accordingly five lamps, which had previously been allowed to burn at an abnormal voltage for nearly 100 hours, had for them the above several quantities determined, and the correctness of the apparatus and personal readings were checked up by the reference lamps whenever observations on the test lamps were about to be made. Table No. 4 exhibits the readings of these lamps. It will be seen that the candle-power determinations vary from about 4 per cent. below to 4 per cent. above the first readings made on the lamps, and hence this table proves conclusively that the conditions of the test were essentially the same at all times of its duration. In addition it may be said that for the determination of the candle-power of these lamps the mean of five observations at the same point was always taken.

TABLE NO. 4.

READINGS OF REFERENCE LAMPS.

Date.	Lamp No. 1 101 volts.		Lamp No. 2 101 volts.		Lamp No. 3 100 volts.		Lamp No. 4 100 volts.		Lamp No. 5 100 volts.	
	C. P.	Ampères.	C. P.	Ampères.	C. P.	Ampères.	C. P.	Ampères.	C. P.	Ampères.
1.2.89	9.94	.505	9.24	.490	9.40	.480	9.94	.495	9.08	.490
1.8.—	10.10	.505								
1.11.—	10.20	.505								
1.15.—	10.20	.500	9.30	.495	9.40	.483				
1.16.—	10.30	.500								
1.26.—	9.80	.500	9.30	.490						
2.11.—	9.55	.500	8.90	.485	9.30	.485				
2.27.—	9.92	.500								
2.28.—	9.66	.500								
3.14.—			9.30	.490						
3.15.—	10.20	.505			9.80	.485				
4.1.—	9.90	.500								
4.29.—	9.70	.505					10.1	.500	9.3	.490

The lamp test was started in August, 1888, at which time all instruments were calibrated, and preliminary measurements were made on quite a number of lamps. On account, however, of press of other work, the test was shortly afterwards dropped until late in December. All apparatus and lamps remained during this interval untouched in the test room, and when again taking up the subject in December, the continued correctness of the instruments was proven by the fact that some ten or twelve lamps tested out then as previously.

In the preliminary measurements of new lamps—the resistance cold—the mean horizontal candle-power and the watts of electrical energy consumed were determined, and from these were deduced the watts per candle, and the candles per electrical horse-power.

In this paper the candle-power of a lamp is taken to be the mean of twelve points 30 degrees apart in the horizontal plane of the lamp. The observed candle-power is the power of the lamp at a point in the horizontal plane at right angles to the plane of the base of the filament. The reduction factor is the ratio of the mean horizontal to the observed candle-power.

In the preliminary measurements three readings were made at the point where the observed candle-power readings were to be made, and the lamp was marked so that this point could always in the future be determined. The lamp was then revolved upon its principal axis, and two observations were made every 30 degrees, the starting point, when again reached, also having two more readings made. The five readings made at the starting point were averaged, and the result called the observed candle-power; the observed candle-power and the readings at the other eleven points were then averaged, and this result called the mean horizontal candle-power.

The wire connections to the lamp in the photometer were the same as shown in Fig. 2, excepting that no voltameters were in circuit.

A sliding curtain was hung from the two photometer screen boards, and an opening was maintained only sufficiently wide to permit the reading of the disc. Two screens of deep blue glass were so placed as to shield the person making the candle-power determinations from all glare of the lights. Two observers made the measurements. The author made the photometric readings and regulated the height of the gas flame, always looking at the flame through deep blue glass, and an assistant placed the lamps in position, adjusted the voltage, made ampère readings, and recorded all observations.

The candle-power readings were always the mean of at least two observations, and if these two differed from each other more than 4 per cent., several others were made, and a mean of all observations taken as the correct reading.

A small room, 13 by 19 feet, in which to conduct the test was partitioned off about 40 feet from the dynamos. In this room were located the photometer and other instruments, and all test lamps. The door leading to this apartment was kept locked, no one being allowed to enter during my absence except the engineer in charge of the plant, who twice a day inspected for broken lamps. The photograph of a portion of the room shows the method of hanging the lamps. They were wired in groups of 10 and 15. Lamps of similar marked volts were placed together.

The volts labeled on the lamps by the manufacturers was taken as being the correct pressure at which to run the lamps. Suitable resistance was introduced into those circuits which required a less pressure than 110 volts, the normal pressure of the house circuits. No lamps were permitted nearer to each other than 12 inches, for fear of possible harm occurring to one from the heat of the others. The temperature of the air when all lamps were burning was about 104 degrees Fahrenheit, as indicated by a thermometer near the centre of the room. The current was turned off and on the lamps during the first 550 hours in a gradual manner, such as was due to the starting and stopping of the dynamo, but after this time arrangements were made to also have the lamps switched off and on once or twice daily, so that the filaments would receive the shock of sudden heating and cooling as in usual practice. Excepting when photometric measurements were being made, the lamps burned whenever the dynamos ran, which was generally 9 hours per diem, 4¾ hours in the morning and 4¼ hours in the afternoon, with one hour intervening. In the mains leading to the test room was interposed a variable resistance coil by which the pressure at the lamps could be adjusted independently of that of the house circuit. Two pressure indicators were connected with the test lamps, one Howell governing the engineer, and one of the United States E. L. Co.'s pattern in the office of the superintendent of telegraph. In the latter place was a push button with which to ring a bell and thus call the attention of the engineer if the voltage varied immoderately. As a matter of fact, the pressure was generally within one volt of the normal as shown by the indicators, which instruments were from time to time adjusted of any variations found between them and the voltmeter in the test room. A written statement was daily sent in by the engineer as to the exact hours of burning and the failure of lamps.

The duration test was started Jan. 2, 1889, and was continued until April 29, 1889, thus permitting those lamps first entered to burn about 820 hours. The lamps contributed by the various companies did not burn this long, because when they were received the test on the purchased lamps was about 200 hours under way.

It was aimed to make candle-power and efficiency measurements of the lamps after they had lived 55, 110, 200, 300, 400, 500, 600 and 850 hours.

In the accompanying curves each make of lamp is designated by a letter. A_1, B_1, C_1, and D_1 have reference to the purchased lamps; A_2, C_1, D_2 indicate those tested at the request of the lamp companies. In either case similar letters refer to like make of lamps.

Three series of curves have been constructed. In the first of these, Plate 1, is shown the variation with age in the economy and candle-power of all the lamps. Each curve represents a batch of from 10 to 15 lamps, thus the C_1 lines relate to the 15 lamps purchased, and the C_2 curves indicate the influence of life upon the lamps contributed by the C lamp company.

The upper set of curves illustrate the economy of the several lamps at their different periods of life. Thus the A_1 curve indicates that these 15 A lamps when new consumed 3.54 watts per mean horizontal candle, that after 900 hours 6.1 watts of electrical energy were necessary to produce one candle-power of light, and further that during 900 hours the mean economy of the lamps was 5.25 watts per c. p.

The lower diagrams indicate the effect of age upon the light-giving power of the lamps. Thus the A_1 curve demonstrates that these A lamps after 900 hours gave but 58½ per cent. of the initial candle-power, and that the mean intensity of light during 900 hours was 67 per cent. of the new lamps.

In the construction of the second series of curves, Plates II. to VIII., inclusive, the lamps have been divided into groups according to their initial economy. Thus A, 2 and 5; B, 13, 46, 49, 50; C, 66, 71, 72, and D, 121 and 126 are all lamps consuming when new from 3.5 to 3.8 watts per candle, and have been used to construct Plate V. We have 7 sets of comparative curves, the various lamps in each set having approximately the same initial economy.

In the third series, Plate IX., we have a summation of all previous diagrams and tables. These curves show the relation between the initial and average efficiency of the incandescent electric lamps studied. These curves are plotted with the initial economy of the lamps as abscissæ, and the corresponding averages deduced from the preceding curves as ordinates. The figures at the plotted points have reference to the number of lamps used in determining each point.

From these curves we learn that the varying of the initial economy between the limits of 3 and 5 watts per candle does not greatly affect the average economy, but it does have a very marked effect upon the average candle-power derived from the lamp.

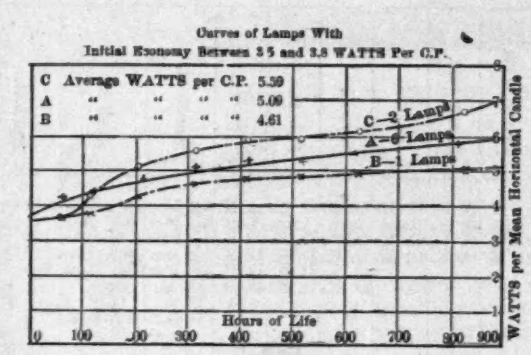

Curves of Lamps With
Initial Economy Between 3.5 and 3.8 WATTS Per C.P.
C Average WATTS per C.P. 5.59
A " " " " 5.09
B " " " " 4.61
C—2 Lamps
A—6 Lamps
B—1 Lamps
WATTS per Mean Horizontal Candle
Hours of Life
C Average Percentage 66
A " " 71
B " " 82
Percentage of Initial Candle Power
Hours of Life
Lamps Used in Constructing Curves Nos.3.4.7.10.11.22.-67.-84.89.

PLATE IV

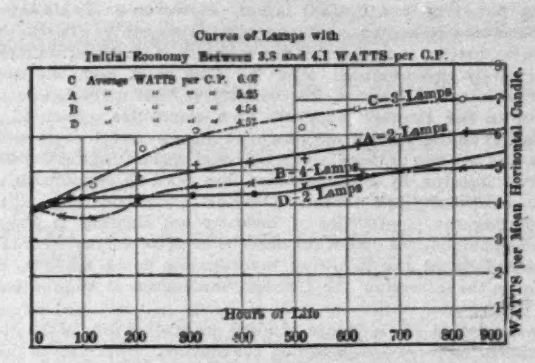

Curves of Lamps with
Initial Economy Between 3.8 and 4.1 WATTS per C.P.
C Average WATTS per C.P. 6.07
A " " " " 5.25
B " " " " 4.54
D " " " " 4.57
C—2 Lamps
A—2 Lamps
B—4 Lamps
D—2 Lamps
WATTS per Mean Horizontal Candle.
Hours of Life
C Average Percentage 67
A " " 73
B " " 86
D " " 88
Percentage of Initial Candle Power.
Hours of Life
Lamps Used in Constructing Curves Nos.2.5.-43.46.49.50.-66.71.72.-121.126

PLATE V

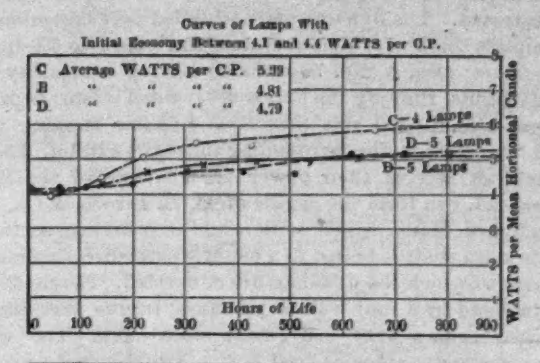

Curves of Lamps With
Initial Economy Between 4.1 and 4.4 WATTS per C.P.
C Average WATTS per C.P. 5.39
B " " " " 4.81
D " " " " 4.79
C—4 Lamps
D—5 Lamps
B—5 Lamps
WATTS per Mean Horizontal Candle
Hours of Life
C Average Percentage 84
B " " 87
D " " 90
Percentage of Initial Candle Power
Hours of Life
Lamps Used in Constructing Curves
Nos.41.48.51.54.55.-65.107.108.105.-81.85.90.123.127.

PLATE VI

THE RELATION BETWEEN THE INITIAL AND THE AVERAGE EFFICIENCY OF INCANDESCENT LAMPS.

TABLE NO. 3.

COMPARISON OF METHVEN STANDARD TWO-CANDLE SLIT WITH SUGG'S STANDARD CANDLES.

Series.	Number of candles.	Brand of candles.	Grains of Sperm burnt.	Rate of burning Sperm per hour for one candle.	Time of making observations.	Average of ten readings.	Corrected average reading.
1.....	2	Sugg's.	40	118.0	10′ 10¼″	1.968	1.936
2.....	2	"	40	114.8	10′ 23½″	2.034	1.942
3.....	2	"	40	116.1	10′ 20¼″	2.064	1.998
4.....	2	"	40	114.6	10′ 27¼″	2.010	1.920
5.....	2	"	40	114.8	10′ 28¼″	2·080	1.984
6.....	2	"	40	114.9	10′ 26″	2.140	2.050
7.....	2	"	40	118.8	10′ 6¼″	2.080	2.008
8.....	2	"	40	119.2	10′ 4½″	2.038	2.024
9.....	2	"	40	114.2	10′ 31″	2.068	1.966
10.....	2	"	40	113.8	10′ 33″	2.066	1.960
Grand average of 100 observations.....							1.984

Electric Lighting in Canada.—The Royal Electric Light Company are busy at present filling the following orders, which have been received within the past few days: Quebec, 1,000-light plant; Moncton, N. B., 600 light plant; Winnipeg, two 500 light plants; alternating system; Mr. Hiram Walker, Peache's Island, for his residence, 200 light plant, and Winnipeg 40 arc light plant.

The Government Telephone Suit.—A special dispatch of June 1 from Boston says: "The United States Circuit Court was called upon to-day to consider another point in the bill in equity to cancel the Bell telephone patent on the ground of a prior invention by Reis, of Germany, by Gray, by Drawbaugh, and others; also, on the ground of fraud by Bell in the Patent Office. The Bell Company originally demurred on the ground of no authority by the United States to bring suit. The Supreme Court overruled this demurrer and ordered the company to answer. It answered and filed a plea. The United States filed a replication. Now the United States asks that an examiner be appointed to take the proofs, and the Bell Company asks the court to restrict the proofs to the fraud issue, on the ground that many of the other grounds for the repeal of the patent set up in the bill are before the Circuit Court in other cases The hearing was finished and the decision reserved."

Power Test of the Daft Electric Railway at Asbury Park, N. J.

BY F. E. IDELL, M. E.

The attention of the street railway companies is being drawn, more and more, to the question of reducing the cost of transportation. They are aware of the fact that new systems are being introduced, and they are ready to adopt these new systems, provided they can do so at a saving in the cost of motive power. Under the present system of horses the railway companies are compelled to keep on an average nine horses per car. Metropolitan lines generally allow twelve horses per car. When this average is lowered, the horses must do a duty of from fourteen to fifteen miles per day, and the depreciation is rapid. Under a wise management, the duty is limited to about ten miles per day. The principal railway companies estimate the life of their horses at from three to five years. Mr. A. W. Wright, of Chicago, says that the cost of the horse department is from 30 to 40 per cent. of the operating expenses of the horse roads in Chicago. Mr. D. K. Clark states that the cost of the horse department of the Leeds Tramway Company, in 1876, was 61 per cent. of the total expenses. In 1880, the cost of the horse department of the London Tramways was between 40 and 50 per cent. of the expenses. Consequently, any saving in the cost of motive power is of the utmost importance to street railway companies.

When other means of motive power than the horse were to be introduced, it became necessary to ascertain the power required to start a car and maintain it in motion. Mr. A. W. Wright made a series of experiments to determine the amount of power necessary to start street cars, and to maintain them in motion at an average speed of five miles per hour. He found that it required a force of 116.5 pounds per ton to start a car, and 15.6 pounds per ton to keep it in motion. These figures are for good tracks. On a bad track he found that it required 134.6 pounds per ton to start a car, and 32.3 pounds per ton to keep it in motion. General Gilmore estimates, for the United States, an average of 16¾ pounds per ton to keep a car in motion with tracks in average condition. Mr. D. K. Clark gives us as an average thirty pounds per gross ton as the average resistance, and states that "an occasional maximum of sixty pounds per ton may be reached, and, on the contrary, a minimum of say fifteen pounds per ton, when the rails are wet and clean, straight and new."

Mr. Clark's experiments were made on grooved rails, which offer a greater resistance than the step or centre-bearing rail. In illustration of the resistance due to the flanges, he gives an instance of a car having four flanged wheels which was drawn over the Paris and Versailles Tramway when the tractional resistance amounted to 22.4 pounds per ton. Three of these flanged wheels were removed and replaced by three flat-tyred wheels. Upon test the tractional resistance was about eleven pounds per ton. For starting cars he gives from 100 to 120 pounds per ton for the tractive force.

The resistance of curves cannot be determined as accurately as the straight track. In writing on resistance of curves, Mr. Wright says: That with the same car and load he found the force exerted on curves to vary between 400 and 1,000 pounds, and the greatest exertion of force upon a curve, when starting a loaded car, was 1,500 pounds, or 283 5 pounds per ton.

Taking a specific case, a 16-foot open car, weighing, with a 15 h. p. motor, 6,200 pounds, and its complement of passengers at 140 pounds each, the total load would be 13,200 pounds, or 6.6 net tons. To start this car on a curve, with a speed in starting from 0 to 528 feet per minute (equal to 6 miles per hour) averaging 264 feet per minute would require

$$\frac{6.6\text{ (tons)} \times 283.5\text{ (lbs.)} \times 264\text{ (ft.)}}{33{,}000} = 15\text{ h. p.}$$

In general service only a small portion of this power would be required, but a maximum of 15 h. p. must be kept in reserve.

The power required to keep the car in motion on a straight and level track at a speed of six miles per hour is:

$$\frac{6.6 \times 15.6 \times 528}{33{,}000} = 1.64\text{ h. p.;}$$

and for starting the car on a straight and level track:

$$\frac{6.6 \times 116\,5 \times 264}{33{,}000} = 6.15\text{ h. p.}$$

It is, therefore, evident that, at times, two horses must necessarily exert several horse-power.

Practical railroad men, when approached on the subject of adopting electric traction in place of horses, cannot understand why the electrical companies should place 15 and 20 horse-power motors under each car. "Why," they say, "we can get along with two horse-power." They fail to recognize the fact that the car horses are called upon at times to exert from five to ten times their normal force, and completely ignore the number of horses per car in use on their own line, which experience has shown to be necessary for the performance of continual daily service.

The average force which a horse can exert at a speed of 2½ miles per hour is placed between 100 and 150 pounds. The experiments of Mr. Wright show that a horse is capable of exerting for a *short* distance 1,530 pounds, or more than ten times the average figure. Under such severe duty it ceases to be a surprise that the average useful life of car horses is reduced to four years.

What can be accomplished, electrically, in street car propulsion is shown in the following account of the electric railroad at Asbury Park, N. J., equipped with, and operated by, the Daft system. It is an example of overhead conduction, the outgoing and return currents being conveyed through parallel wires suspended over the track. The road is a belt line and, with the exception of that portion along Cookman avenue, is single track, with switches placed at given distances. The maximum grade is 1 per cent., and the curves 50 feet radius.

At the time of the test fourteen cars were running on the road, six each way around the belt and two along Cookman avenue, between the railway depot and the beach. A 15 h. p. motor is placed under each car, and is carried by two I beams resting on the axles. The armature shaft transmits its motion to the axle of the car by means of spur gearing. By means of a "trolley" and "tow-line" the current is carried from the overhead wires to the electric motor. The current for each car is regulated by means of a switch-box, at both ends of the car, under the control of the driver or "motor man." This enables him to start gradually and without shock, and, when once in motion, to obtain the maximum speed in the minimum of time.

The power station is located on the west side of the tracks of the New York and Long Branch Railroad, on the corner of Railroad and First avenues. The main current leads are run from the station about two blocks before they join the loop connecting with the trolley wires.

In the boiler room there are three steel tubular boilers built by the Phœnix Iron Works, of Meadville, Pa., of 85 h. p. In the engine room there are four Dick & Church automatic engines of 60 h. p. each, when running at 300 revolutions per minute under 80 pounds initial pressure of steam. These engines have piston valves. The engines, when running, are belted to a line-shaft carried on brick piers placed in the centre of the room. Five dynamo generators, each of 50 h. p. capacity, are belted to the shaft on the side opposite to the engines. The switch-board is placed on the wall of the building near the dynamo generators, which are run in multiple. During the test three engines and three dynamos were in use.

The test of the power required to drive the cars at Asbury Park can be separated into two parts, viz., the boiler test and the engine test, and will be considered in this order.

Boiler Test.

The boilers are each 60 inches diameter, 14 feet long, with 82 three inch tubes 14 feet long. The test was commenced at 5 A. M., Aug. 28, and ended at 12 midnight, Aug. 30, 1888; making the total period 55 hours. Steam was raised in the boilers to a pressure of 70 pounds per square inch at 4:30 A. M., when the fires were drawn, the grates and ash-pits cleaned and a new fire started at 5 A. M., with 106.5 pounds of wood (42.6 pounds combustible). The height of water in the boilers was the same at the end of the test as at the commencement. The water was measured by a "Crown" water meter, which was, by test, found correct. A duplex pump forced the water through the feed-water heater into the boilers. A constant feed was maintained during the test. The average temperature of the feed-water just before it entered the boilers, for the whole test, was 207 degrees Fah. Half-hourly readings were taken of the steam pressure, temperature of the feed-water, and temperature of the boiler room. Readings of the water-meter were taken every hour, and also the weight of coal delivered to the fireman. The ashes resulting from each day's run were weighed the following morning.

The total amount of coal delivered to the fireman, including that used for banking two nights, was 27,783½ pounds. The total weight of ash was 4.211 pounds, or 15 per cent. Included in this is ash, clinker and such unburned coal as had dropped through the grates.

The total fuel was:

Coal	27,783.5	pounds.
Wood	42.6	"
	27,826.1	"
Less ash, etc	4,211.0	"
Combustible	23,615.1	"

The total amount of water fed to the boilers at 207° F. was 253,812 5 pounds. The average steam pressure per square inch was 77 pounds.

The pounds of water evaporated per pound of coal under actual conditions were 9 1; the pounds of water per pound of combustible at actual pressure 10.74, and the pounds of water evaporated per pound of combustible from and at 212° F. 11.04.

Engine Test.

The engine test was commenced on Aug. 29, at 6.15 A. M., and ended Aug. 30, 1888, at 10 30 P. M., making a total period of 35 hours. Two indicator cards were taken from each of the three engines in operation every 20 minutes during the day, and half-hourly during the evenings. The engine friction was found to be 10.03 horse-power, 6.47 horse-power and 6.13 horse-power, respectively.

The excessive friction of the first engine was probably caused by some journal box or gland being set up too much; it could easily have been lowered to the other figures, had there been time to make the correction, but as the test was in progress this could not be done.

The greatest indicated power obtained during the test averaged 8 horse-power per car. This includes the friction of the engines, shafting, dynamo-generators, loss due to the electric resistance of the line and the resistance of and work done by the motors. The average power consumed in each motor was only 1.9 horse power. This figure is the result obtained from 450 indicator cards. The regulation of the engines was excellent.

During the test, readings of the tachometer were taken half hourly; the average for the two days was 335 revolutions per minute, which is about $\frac{7}{10}$ of 1 per cent. below the normal speed. The variation in the demand for power upon the engine was, at times, as great as 17 h. p. within the period of two minutes, and under these extreme conditions the regulation of the engines was exceedingly good.

The number of pounds of coal per h. p. hour on an average was 5 9. In the calculation for this figure and those, following the coal used in banking the fires on both nights of the test is taken into account. The object in so doing being to give the results of actual working conditions with reference to the consumption of coal per h. p., it will be noted that there were in operation three engines rated at 60 h. p. each, or 180 h. p. total, developing a maximum of 112 h. p., while the average h. p. for the two days' run was less than one-half the normal rating of the engines. Under these unfavorable conditions the economy could not be as great as if they were running at full load. But taking the plant as found, the economy is very near the figure obtained from high speed engines under very much more favorable conditions of load.

The average number of passengers per trip during the test was 23, or, with "motor man" and conductor, 25. The average load was, therefore, 25 × 140 = 3,500 pounds, and the total load, including the weight of car motor, 9,700 pounds, or 4.8 tons. The average time per round trip of 3¼ miles, including numerous stops for passengers, was 40 minutes. The first trip in the morning is generally made in 20 minutes. The average rate of travel was, therefore, 5.7 miles per hour, with a maximum of 11.5 miles per hour. The total amount of coal consumed per car per hour was 36 pounds, or 1.31 pounds per ton per mile.

With a power-plant capable of driving 20 cars, and running but 14, the cost of motive power per car, in use, was about $3 13 per day of 17 to 18 hours. This includes interest and depreciation on the cost of the power-plant, motors under the cars and overhead system, wages of two engineers and two firemen, coal, oil, waste and water.

If 20 cars were run the cost of motive power would be about $2.68 per car per day. If horses were used, 140 to 200 would be necessary for the same service, and the cost of keeping these would be at least fifty cents per day per

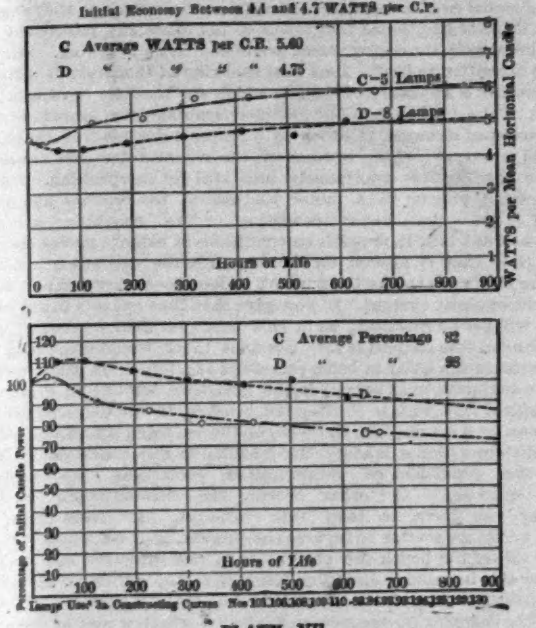
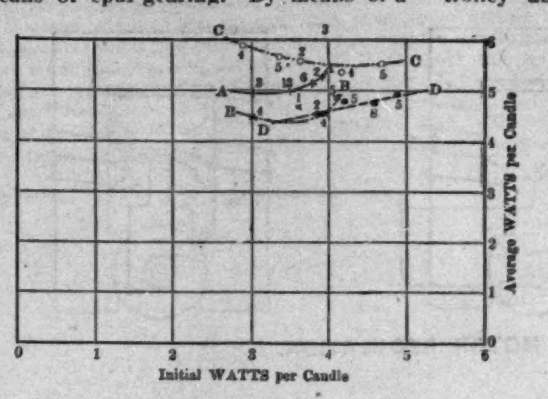

Curves of Lamps with
Initial Economy Between 4.4 and 4.7 WATTS per C.P.
C Average WATTS per C.P. 5.60
D " " " " 4.75
C—5 Lamps
D—5 Lamps
WATTS per Mean Horizontal Candle
Hours of Life
C Average Percentage 82
D " " 98
Percentage of Initial Candle Power
Hours of Life

PLATE VII



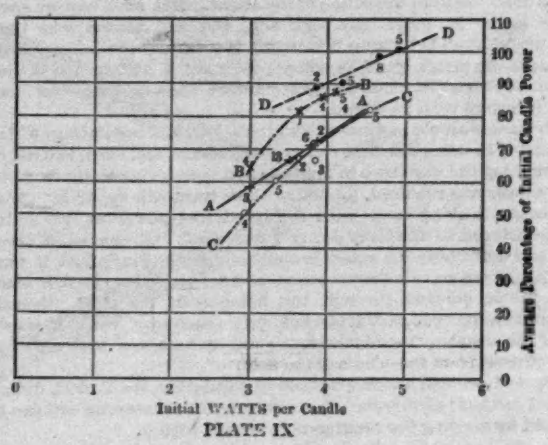


PLATE IX

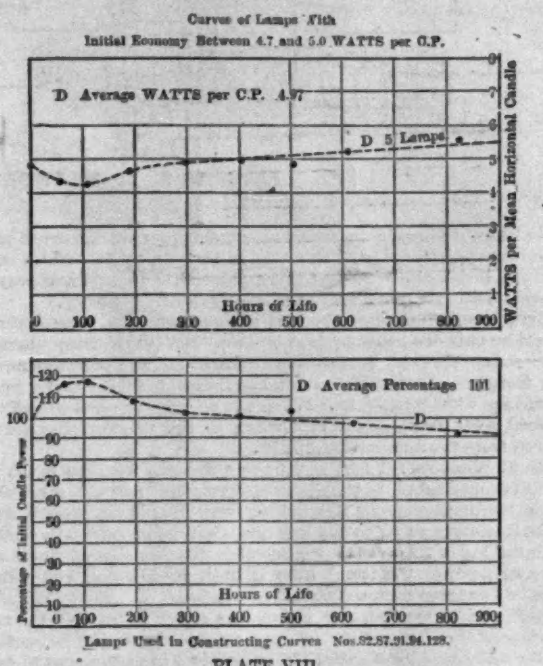

Curves of Lamps with
Initial Economy Between 4.7 and 5.0 WATTS per C.P.
D Average WATTS per C.P. 4.97
D 5 Lamps
WATTS per Mean Horizontal Candle
Hours of Life
D Average Percentage 101
Percentage of Initial Candle Power
Hours of Life
Lamps Used in Constructing Curves Nos.82.87.91.94.128.

PLATE VIII

THE RELATION BETWEEN THE INITIAL AND THE AVERAGE EFFICIENCY OF INCANDESCENT LAMPS.

* From *The Stevens Indicator.*

horse, or $5 per car per day. Interest on investment in horses and stables would increase this figure to $5.50 or $6 per car per day. Consequently at Asbury Park the electric road is being run at one-half the cost that a horse road would be in the same locality. Here the electric road has a decided advantage, for during the winter months but four cars are run, requiring one boiler, one engine and one dynamo-generator, and, while the cost per car for motive power is higher than in the summer months, it is still lower than it would be with animal traction.

This is due to the fact that the horses, if kept, would cost from 50 to 60 cents per horse per day, whether doing work or not, and even if the number of horses was reduced by sale to 40—those sold in the fall of the year bringing but a very small price after the severe work of previous summer—a new stock of from 120 to 160 would have to be purchased in the following spring at a high price. This difference when charged against the motive department would make the average cost per car per year very much greater than for the same number of cars on a road using electricity as a motive power, which loses only the interest on the investment during the winter.

Motor Regulation.

We print below the discussion on Mr. F. B. Crocker's paper on "Motor Regulation," read before the American Institute of Electrical Engineers,* Prof. Elihu Thomson presiding.

MR. WOLCOTT: I would like to ask Mr. Crocker if he has ever observed any difference in sparking between moving one brush and both brushes. So far as I have seen, in those machines which only use one brush the sparking is immaterial. I do not know why it should be so. I never worked out any satisfactory theory.

MR. CROCKER: It would be half as much anyhow, because there would be only one brush instead of two. But very likely there is some reason for that. I have never observed it, and therefore never con idered it. It is possible there may be some action there, but I do not see what it could be. When one or more brushes are off the neutral point they spark in proportion to the amount they are removed from the non-sparking point.

MR. T. WOLCOTT: I can show you a dynamo with one brush on what is supposed to be the direct contact point and the other one, about 100 degrees from it, sparking very little more than it does when it is set opposite to it. But this is a dynamo especially that I am speaking of. I do not know whether the same thing would apply with a motor. This machine is built for 25 lights, and is running two or three lights.

MR. EDWARD WESTON: Of course, the sparking between the two sections of the commutator of any machine would be dependent on the difference in potential of the sections in passing out of contact with the brushes. That would depend on the number of sections in the commutator and the electromotive force between the bars. That would still further be complicated by changes in the field by moving the brushes. It would be a very complicated question to discuss. I can well understand how you could have a machine in which one brush or both brushes could be moved from the so called neutral point to the point of no current and it would practically give no spark, and then, again, you could have a very heavy spark with some types of machine. With some types of machine, such as the Brush, it could not be done very well. If you vary the current, and so change the difference in the potential of the strip, of course you get a great deal of sparking.

MR. CROCKER: I understood Mr. Wolcott to say that it was a 25-light machine running two or three lights.

MR. WOLCOTT: Yes.

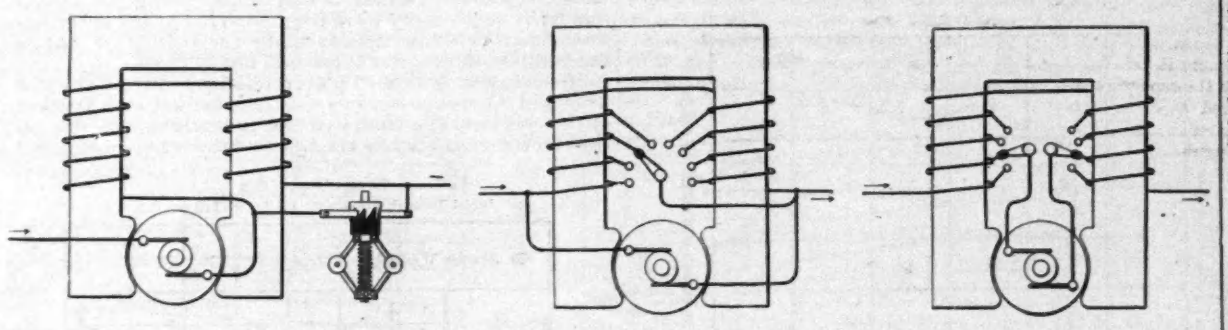
MR CROCKER: Of course, in that case it was intended for a great difference of potential between the commutator bars, and it was really working with only one-tenth its normal difference of potential. Therefore the sparking would be reduced just in proportion to that. It is hardly a fair case—a motor or dynamo running at only one-tenth of its power. Of course, the sparking and all other effects are changed—the heating of the coils and everything else.

MR. WOLCOTT: The current is the same. I understood Mr. Crocker to say that the sparking would be worse as you went away from the correct commutating point, so when you get down to two or three lights it ought to be worse than ever. The sparking is not very bad anywhere.

DR. S. S. WHEELER: The principal cause of sparking in regulating motors is the fact that you are constantly changing something, either on the magnetism of the armature or the field, in order to produce your regulation, and as soon as you do that you change what is called the line of resultant magnetism, and although the brushes are standing still you have moved the non-sparking point away from the brushes, and you no longer have got the brush in the right place. Of course, there are two causes of sparking—one is the breaking of the circuit between the brush tip and the commutator, and the other is due to short-circuiting between the bars. To avoid short-circuiting you put the brush where there is no difference in potential between the bars. If you change the potential of the field or the armature you will shift what is called the line of resultant magnetism, and the brush will no longer be on the right spot. For that reason the method of regulation shown in Fig. 6 of Mr. Crocker's paper, in which the whole current of the machine is shunted at all times in the same proportion, has the advantage that it will never spark, because, although you alter the power, you alter the armature and the field both equally. That is the worst method of regulation there is, but it has that one advantage.

There is one other method of regulation that might be interesting though it is not at all practical, Fig. 1. That is supposed to represent a motor, which has a commutator that has teeth moved longitudinally by a contrifugal governor. There are two brushes resting on the commutator which are connected so as to short circuit the field coil. As this revolves, if the brushes touch only the tips of these teeth, there will be a metallic connection for only a very small portion of the whole time. If the commutator moves the other way, the brushes will be in contact most of the time, and there will be almost a continuous short-circuit around the field. Now, it takes some seconds for the magnetism of the field of an ordinary dynamo or motor to change. Consequently, if you make and break the circuit which short circuits the field very rapidly you will not lose your magnetism entirely and get it all again; you will simply let down the degree of magnetization, but keep it steady at some point, depending on what proportion of the whole time the circuit is closed and what proportion it is open. If you have a saturation curve like that (indicating), and suddenly put a whole current on up a shunt there, which represents five seconds of time to saturate, then if you put a commutator, which will put the circuit on to the field and off again, you will get that point of saturation. If you have a current on a quarter of the time, you will get about there, so that the governor will regulate the strength of the magnetism. Of course, it is not practical at all.

There is one other method of regulation; I do not remember whether it was touched upon or not; I do not think it was, although it comes under one of these as a sort of sub-class. Suppose that, as in Fig. 2, the field magnet and the armature are connected in multiple arc. Now, if you have a switch which shunts various portions of this field coil, you will reduce the maximum of the field, and at the same time you will be shortening up a shunt which is placed around the armature. So that you get a machine in which you reduce the armature magnetism, and reduce the field magnetism in something like equal proportion, without the use of any outside dead resistance. But that has the very serious objection, which is fatal, that the minute this armature speeds up, the counteraction



FIGS. 1 2, 3.—METHODS OF MOTOR REGULATION.

once more changes the action of the shunt. But such motors have been made in large numbers, and the only reason why they are useful at all is because this switch is generally moved over here to make the motor speed up when you want a higher speed, and then, of course, the counter-electromotive force so produced does not interfere with its action.

There was an old method of Sprague's, Fig. 3, of regulating, which consisted in using the field coil as a long shunt, and then, instead of connecting the armature in multiple arc, connecting it there when full power was required, by sliding these terminals down by suitable contacts along here, until the speed and power of the motor were reduced to whatever power was desired. Of course, if these are slid down here the action is doubled. In the first place, it puts the armature on to a shorter shunt, and in the second place, it sends the whole current through the balance of the field, thereby strengthening that part of the field very much over what it would be if the armature terminals were away up here, and took a part of the current from the whole of the field.

Fig. 4 shows still another method of regulation, the C. & C. differential method; in this the effect of the series differential coil can be varied by varying the resistance in circuit with it.

MR. JOS. WETZLER: I would like to ask Mr. Crocker whether he has ever considered the Waterhouse three-brush regulation as applied to motors.

MR. CROCKER: I have considered the matter somewhat, but I never went into it at all deeply. It never was a very attractive method of regulation to me, but I cannot say whether it would work or not. I think very likely it would. The condition in a constant current motor is very similar to that in an arc light dynamo. If a certain regulation is a good thing for an arc light dynamo it is probably equally good for a constant current motor. That is quite universally true. But, of course, this cannot be laid down as an absolute rule. You would have to apply it in each particular case before you are sure of it. But on general principles it is true. However, I have not considered that particular case enough to give any opinion of it.

MR. C. O. MAILLOUX: There is a very peculiar fact with reference to three-brush regulation, in connection with the sparking, which was brought to my attention a year or two ago. I am sorry that Mr. Hamilton, the former chief electrician of the Western Union, is not here, because he is the man who made the discovery, if it may be called a discovery. Suppose that to be the commutator of the machine (Fig. 5). I had occasion to design a machine for telegraphic work, where it was expected to use a third brush for the purpose of getting varying electromotive forces, so that if this were the neutral line the total electromotive force would be, say, 20 volts. Then he proposed to use a third bru h and to vary that brush so that we would get different circuits—a large number of local circuits—and by changing this brush he could fix it so that there would be either ten on each side or else five on one side and fifteen on the other side. I recollect at the time it was a question as to the possible amount of sparking, particularly inasmuch as he expected to carry as much current from one side as from the other, and as sometimes one-half would not be working and the other half would be working entirely, it was a question whether there would not be great sparking there, and he told me that he proposed to avoid that entirely. I was greatly interested to know how he proposed to do it, and to my great surprise I found that he had done so entirely by this simple expedient of putting another brush on the opposite side and connecting them together through a simple galvanometer. Now, we found by practice that as long as these two brushes touched correspondingly so that they were of equal potential, so that there was no current passing thr ough that galvanometer, there was absolutely no sparking—not the slightest trace of it. If we disturbed that connection and if there was no appliance between the two, there would be very excessive sparking; but in any case it did not matter where the brushes were located, provided that both of them were located at the same point. For instance, if he wanted to get only a small part on this side, he might have one brush touch here and the other brush would have to move there. I cannot exactly account for the phenomenon; perhaps somebody here may. It was a very interesting case as showing that there is yet a great deal of mystery to be elucidated about the sparking of dynamo brushes.

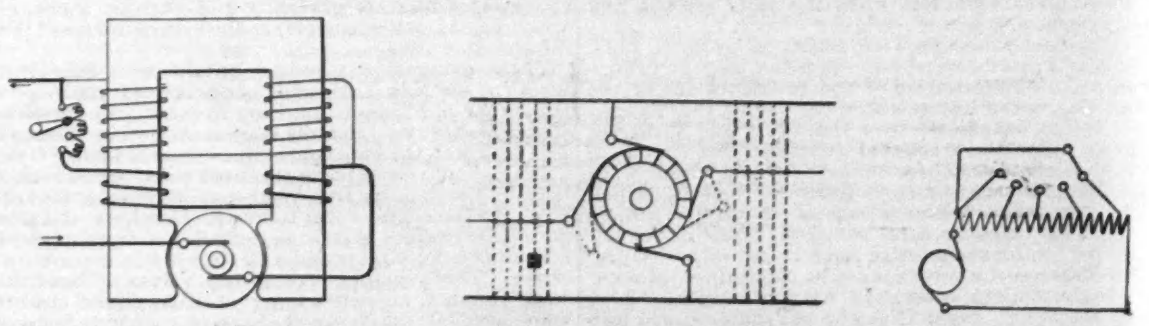
PROF. NICHOLS: Mr. Crocker's opinion that any method for the constant regulation of dynamos may be applied to motors with chances of success at least, I concur in. The behavior of third brush regulator machines is a pretty complex question, and by no means yet worked out, and it depends upon a great variety of facts which we are scarcely yet masters of. We have been studying that at Cornell to some extent and have gained some light on the subject, but the matter, as far as we are acquainted with it, is certainly hardly in a condition to be presented here.

MR. WESTON: The last case given by Mr. Mailloux would certainly be a very singular case. I am entirely at a loss to understand it. Under the conditions named it would indicate that the difference of potential between the strips had nothing to do with the sparking of the commutator. I shall take the first opportunity to try that experiment, as it seems to me a very remarkable case.

MR. MAILLOUX: I should state that the galvanometer is only used for adjustment and that the two brushes are connected by a metallic connection of low resistance, so that the current supplied to the circuit is derived in equal proportion from both of the two additional brushes. The same thing could be accomplished by connecting a portion of the circuit to each brush.

THE PRESIDENT: It is my experience that in the designing and working of the dynamo there is no machine so capable of giving unexpected results sometimes as certain proportionings of dynamo. Mr. Crocker mentioned that in one of his cases the movement of the brushes in the motor would produce violent sparking. Now, I take exception to that. I say that sparking of that kind is within control, as is the case in dynamos which are built for constant current. Take, for instance, the modified Gramme form known as the "American" dynamo, in which by a proper adjustment of the over-reach or over-lap of the brushes of the commutator you can displace the brushes enormously and still get no sparking. Apply the same process to a motor and move the brushes and you will get the same condition. The sparking at the brushes, as I take it, depends on conditions of balance giving the exact time that is needed for the current in the coil which is going under the brush to lose the current it has been carrying and take up the opposite current. If you give that time exactly in any case you will get no sparking; as in this case your field is constant and your armature current is also constant there would be nothing to prevent such a balance being preserved at all time. In other words, if we commute our currents in the armature bobbins in a certain density of field, and, in shifting the brushes, do not disturb the conditions, or if we do disturb those conditions, bring into action other conditions which will adapt the machine to the condition of field or the condition of commutation, then you can control the sparking. In other words, the self-induction is the thing you have to take into account. It takes time in any armature section to reverse the current, and we know that on one side of the brush the current is in one direction and on the other side in another direction. Keep, then, the coil under the brush for just that time which allows it to pass from 5 ampères, which it may be carrying on one side, to 5 ampères which it may be carrying on the other side, and you have no sparking in any case. That is one reason why flexibility exists in many forms of dynamo, especially where the armature has a controlling effect in the field; that is, it has some influence on the disposition of the magnetic forces. In cases in which the field is abundantly strong and the armature is a weak magnet then, of course, the commutation is made in a rather weak field just before the bobbin reaches the strong field. But if the commutator is placed under the field, that is, when the armature bobbin is passed forward under the field, then the conditions are all changed.

I would like to add, also, another case to Mr. Crocker's cases—one which I worked at for some time, and which I found was a fairly satisfactory solution of the problem of constant current motors. I have not very much faith in constant current motors anyhow. They always require some extraneous mechanism like a governor or something of the kind which varies the conditions, and that governor is apt to be behind time, especially on light loads. It may set the motor oscillating. The case is very similar in series work with constant current to what we find with arc lamps with constant potential. In fact, we have instability with arc lamps on constant potential, and we have instability with motors on constant current, for the simple reason that the lowering of speed in the motor drops the counter-electromotive force, and we only have a definite certain current to work on; that means a drop in the actual amount of energy available. The time the motor needs more energy to bring up its speed is the time it loses the energy, and that is analogous to the rush of current that will go through an arc lamp put in multiple on a constant potential circuit, because the resistance of the arc falls with the increase of the current. Consequently the more current passes, the more current will pass, and the more hot vapor is produced. The case which I referred to as an additional case is one which for constant current purposes the field is wound in shunt with the armature, Fig. 6. We have the field in shunt with the armature but we vary the field coils in their thickness. We start



FIGS. 4, 5, 6.—METHODS OF MOTOR REGULATION.

*THE ELECTRICAL WORLD, June 1, 1889.

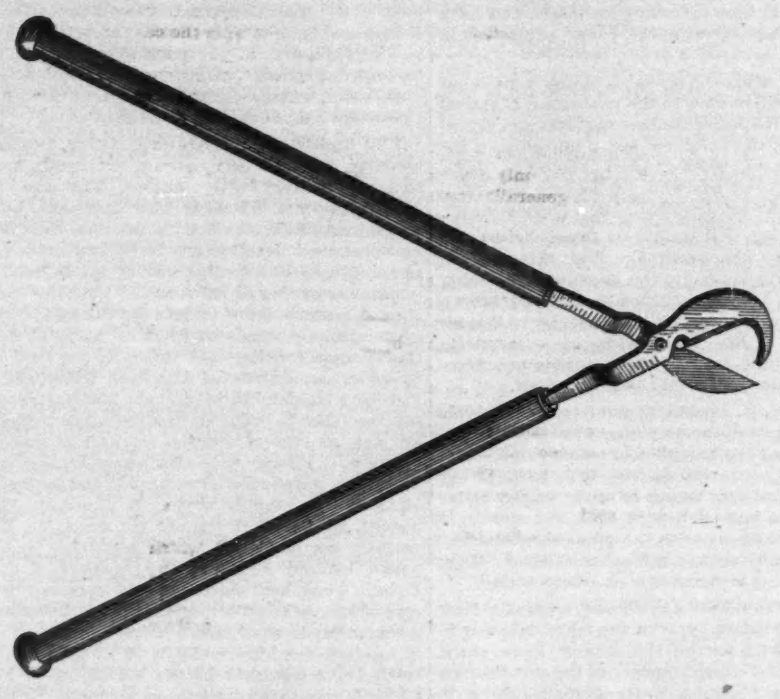
with thick wire and we go down thinner and still thinner until we end with a rather thin wire. We now make our connections from this at various points and put a governor on the motor shaft which will give us a contact to traverse these connections. The armature and field being in shunt the current will always divide between them and it will be seen that when we have this contact over here to the right we have a comparatively high resistance field, or, in other words, we have something like a shunt machine, that will be the condition under heavy load. As the load comes off and the speed rises the contact passes to the point shown in the diagram. We get then a low resistance field. The current passes through this branch in greater proportion than through the armature branch. The field being low, resistance is an economical field and we get in that way a very fair and economical regulation for series motors. I have built motors on that plan and found they worked very satisfactorily, indeed, with a proper arrangement for moving the contacts. There is another advantage that I find in such a motor, that the brushes are practically sparkless. That is, they may be set in one position, require no movement at all, even on so few segments as a three-coil armature, and of course on a Gramme armature and a multiple segment machine the constancy is even greater, but the brushes are simply set at a certain angle with the line joining the fields, and the governor takes care of this process. The objection to it is that it requires a rather nice construction of the machine. You begin with a coarse wire and go down finer and finer, and to get the grading nicely is a matter of calculation, of course.

Mr. CROCKER: I would just like to add one word. I think there is a great difference between motors and dynamos in one respect, and it is a purely practical one; that is, that the dynamo is handled by men who know how to handle machines, whereas motors are in exactly the opposite position—they are usually in the hands of the most ignorant people. Therefore systems of regulation which are perfectly allowable or practical in the case of a dynamo are not so allowable or practical in the case of a motor. In fact, the case spoken of, about a nice balance in the position of the brushes, is an illustration; that is all right in the case of a dynamo where it can be maintained. It probably could not be maintained in the case of a motor. In speaking of shifting the brushes I referred more to motors than to dynamos. I was not talking about dynamos or criticising dynamo regulation. But I think that motor regulation is different in the respect I have stated and that is about the only difference that there is—the only radical difference.

The PRESIDENT: I would say that we find in working the carbon brushes that you can have quite large variations on account of the resistance of the brush. The spark will be almost insignificant—the resistance of a brush is opposed to any sparking or short-circuiting.

Electric Light Wire Shears.

In extinguishing fires, the firemen sometimes find it necessary to cut the telegraph or electric light wires, and in order to guard against accidental shocks from live wires, the D. A. Woodhouse Manufacturing Company, of this city, have constructed the shears shown in the accompanying illustration. There are provided with handles 3 feet long covered with heavy rubber so as to prevent shocks. The blades have a cutting surface of 4 inches and open 4 inches, allowing of a leverage sufficient to cut any wire.



ELECTRIC LIGHT WIRE SHEARS.

Clark's Tubing Machine for Electric Wires.

The tubing machine illustrated on this page has been patented and introduced by Mr. Edred W. Clark, of Hartford, Conn., for the manufacture of rubber tubing and for the covering of electrical wires of various classes.

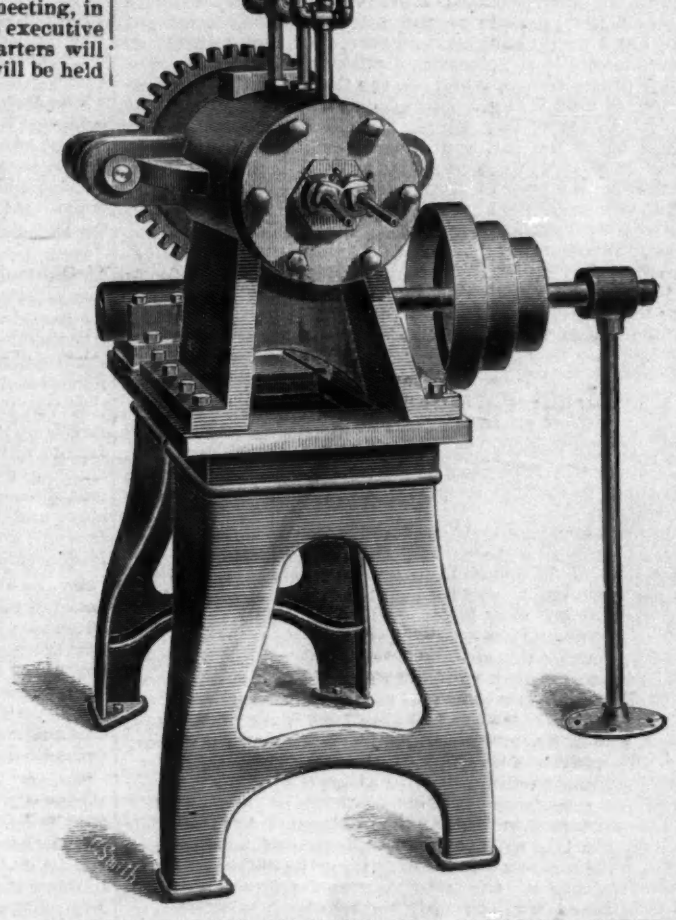
In the manufacture of tubing, all the sizes from ¼ inch to one inch inclusive are produced two at a time, and on a medium size, such as ½ inch, the machine is capable of producing 15,000 feet per day.

The length of cylinder and size of bore are such as to secure a perfectly even working and heating of stock before it reaches the dies.

The heads are the same size of bore, and the cores are fitted to the same. When changing from one size to another or in cleaning the machine, the unscrewing of the one bolt head removes everything without trouble or delay.

All of the heads have nipples that will *interchange*, varying in size by $\frac{1}{64}$ of an inch, so that the thickness of the walls of the tube can be made as heavy or as light as desired. This is found advantageous, as changes can be made without altering the adjusting screws, and without loss of time, merely unscrewing one pair of nipples and screwing in another. The heads have cores from ¼ inch to ½ inch diameter, varying by sixteenths. The nipples run from ¼ to one inch, varying by sixty-fourths. The cylinder has three separate and distinct steam spaces that run entirely around the cylinder, thus giving an even heat at all points.

To the above, which with the cut will give a good general idea of the machine and of its *modus operandi*, it may be added that for wire covering another style of head is used. This special fixture for wire is made either single or double, the single for wire of larger sizes than No. 10 and the double for all sizes smaller than that. The wire fixture screws into the machine in the same manner as the tubing fixture. The rubber or other compound is fed into the hopper, and the wire feeds through the fixture at right angles to the machine. The wire requires no special feeding, as the friction of the insulating compound as it is forced along and out of the dies is sufficient to draw the wire as fast as the compound itself will feed. The fixtures are so made that the wire can be adjusted by set screws so as to keep central in the covering. Any thickness of covering an be produced, and all sizes of wire smaller than No. 10 can be covered two at a time.



CLARK'S TUBING MACHINE FOR ELECTRIC WIRES.

The National Electric Light Association.

The above association has begun to issue a bulletin, which promises to be of great use as a means of communication and intercourse between the members, enabling them to get and give information and to learn what the secretary and the various committees are doing. In the first issue, Mr. A. V. Garratt, the secretary, gives details of arrangements for the Niagara Falls meeting, in regard to which Mr. B. Rhodes, chairman of the executive committee, is actively making plans. Headquarters will be at the International Hotel, and the sessions will be held in the new Casino adjoining. Indications are that the attendance will be large and that many of the members will be accompanied by their wives and friends.

The Bulletin contains also lists of the officers, committees, honorary members and members.

Mr. Garratt invites all who have ideas on the subjects that they consider should be brought up at the Niagara Falls convention to write to him suggesting topics and likely authors of papers. The secretary's office is now at 18 Cortlandt street, this city.

The date of the convention is Aug. 6, and Mr. Garratt is already issuing the blank forms for those who desire to avail themselves of concessions in railway fares.

Meeting of the Board of Electrical Control.

The Board of Electrical Control met on the 28th ult. Commissioner Gibbens presented a report from which it appeared that 1,685 poles and 1,140 miles of wire have been removed since Jan. 1. A report read by Dr. Wheeler showed that the East River Electric Light Company has a line of wires on each side of Third Avenue, the Bowery and Park Row, and recommended the transfer of the company's poles to one side of those streets. The Board ordered that the Western Union Company maintain lines of wires on one side of the street only in a number of streets, where at present it has lines on both sides.

From a statement made by Commissioner Gibbens, it appears that the removal of the poles and wires has been delayed considerably by the failure of the Fire Department to remove its wires. The Mayor said he had written to President Purroy that his want of action was hampering the work of the Board, and he had urged him to expedite matters as much as possible. There was a discussion about the wires of the Western Union Company in Tenth avenue, which the inspectors of the Board report as dead, but which, the company says are in actual use. Superintendent Humstone explained that among the wires in question were several of the Pennsylvania Railroad Company, the New York Central and the Erie Railroads, and others connecting with the sixteen offices of the company on the west side of the city. He thought the demand made by the Board was unreasonable and certainly hard on the company: it was virtually, that the company should cut off their offices, and then wait for the Board to allow them to make connections again.

The company was perfectly willing to do all in its power to meet the wishes of the Board, but the line of action now proposed would make such acquiescence very difficult. Mayor Grant said that the intention of the Board was not to prevent the companies from operating their lines, but to insist that they go into the subways wherever there are subways. There could be no objection to the Western Union Company putting their wires on the Ninth Avenue Elevated Railroad structure. It was decided to lay over the matter to a future meeting, when a formal proposition of the company to remove the Ninth avenue wires to the elevated road structure will be considered. With reference to the application of the Metropolitan Telephone Company to string wires on poles from the Bronx River to Vise avenue, Mr. Cutler, vice-president of the company, stated that they had laid down a long distance telephone line to Boston at a very heavy expense, and had incurred serious loss while waiting several months on the Board for permission to complete it. He pointed out that the line had been run under a permit of the Board, and just when they were about to complete it the Board revoked all permits on unfinished lines and placed them in a trying position. The permit was granted.

It was resolved that Corporation Counsel Clark be requested to act as counsel for the Board in the action pending in the United States Circuit Court, wherein the American Rapid Telegraph Company seeks to restrain the city from interfering with its wires. A large number of applications were granted to string short telegraph and telephone wires for private use in various parts of the city.

The Board met again on the 29th. A number of applications for permits to run electric light wires were presented. The Mayor said the Board should move very cautiously, as he believed that every company, even the United States Illuminating Company, had violated the law. Mr. Jackson, president of the United States Company, asked to be allowed to make an explanation in regard to the recent violation of the law of which the company was reputed to be guilty. Mr. Jackson said that the lamps in question were in the markets, and were used on old circuits. The loops were already there, and the lamps were only re-attached. He had understood from his superintendent that special permits were not required, as no wire was strung. So soon as he had discovered that it was against the law he had had the lamps removed. The Mayor said it was unfortunate for the company that the Board had detected the matter before Mr. Jackson. The latter said that the infraction of the law was undesigned so far as his company was concerned. They had not the slightest intention to act contrary to law or to the views of the Board in any way; but if the Mayor would not accept the explanation he had offered they must take the consequences, whatever they might be. The Mayor refused some applications sent in by the United States Company for the erection of lamps in districts where there are no subways, but on consultation with the Commissioners he decided that it might be as well to grant them, otherwise the public would be more punished than the company. It was also implied that the proceedings contemplated against the company will be stayed.

Permits were further granted to the Manhattan Electric Light Company, the East River, Brush, North New York and the Mount Morris electric light companies for making overhead connections, and placing lights in various parts of the city.

The Mayor said it had been brought to his notice that the electric light companies were charging about 50 per cent. more in the subway districts than they formerly

charged. At the present rates charged by the subway companies he understood that the subways would be paid for in five years. He had heard no complaint, but if any of the companies had anything to say on the subject he was ready to listen to them.

Mr. Jackson said the United States Company had made no appreciable increase in the price of electric light supplied by current through the subways, and Mr. Foster, of the Mount Morris Company, said that if the intention of the Board of which the Mayor had just made mention, to adjust the rates charged by the subway company, were carried out, his company would reduce its rates in the subway districts to the ordinary rates. The meeting adjourned subject to the call of the chair.

The Constitution of the National Electric Light Association.

Great interest is taken by the members of the National Electric Light Association in the constitutional questions that have arisen as the result of the discussions at Chicago, and the matter is being quite earnestly debated in many quarters. We have recently had an opportunity of seeing a letter addressed by an active and prominent representative of one of the "supply" branches to an officer of the Association, and take the opportunity of printing a portion of it that bears on some vital points:

"My position is this, that the National Electric Light Association means just what the name implies, that it is an association of electric men, meeting for the purpose of discussing the various questions pertaining to their good. but the way the thing is drifting, I am afraid that it will be a National Supply Convention instead of Electric. This I am bitterly opposed to. I want the convention to remain purely electric, and I would suggest that the supply men be disfranchised from voting on any and all questions that pertain to the interests of electric light men; but I would suggest, however, that they be allowed to have a vote in the election of officers.

"It is pretty rough, when, on the floor of your own convention, a man will get right up there and say that you have got to accept any supply in spite of yourself. This is carrying it too far, and compelling a man to buy that which he knows in his own judgement is not practical, and that he is a loser of money by.

"I have been doing a great deal of talking to electric light men who own stations, and who are not members of the National Electric Light Association, telling them of the danger which they are running by not co-operating and meeting in a body to vote down anything that may come up to their detriment, and I think that the membership will be increased considerably."

The National Telephone Exchange Association.

Gen. C. H. Barney, the secretary of the association, has issued the following important notice to members and others intending to participate in the Minneapolis Convention.

"For the accommodation of delegates and others from the East proposing to attend the next meeting of this association at Minneapolis, the Pennsylvania Railroad Company propose to run a special vestibule train of Pullman cars of the very latest pattern through from New York to Minneapolis without change. The train will consist of five cars, three sleepers, one dining car and one composite car, containing smoking room, library, bath-room and barber shop. It will be run as the second section of the famous 'Chicago Limited,' leaving New York on Sunday, Sept. 8, at 9 A. M., arriving in Chicago twenty-four hours later. Monday will be spent in Chicago until 5:30 P. M., and Minneapolis will be reached about 8 A. M. on Tuesday morning.

"This arrangement will enable delegates to take their ladies on the trip with the utmost degree of comfort, and several have already announced their intention of doing so, thus making of the trip a grand telephone family party. Tickets will be only the regular fare, $38.50, including berth.

"In order to secure this magnificently equipped train, it will be necessary to guarantee 18 passengers to each sleeper, or 54 in all. The train will take on passengers at Philadelphia, Harrisburg and Pittsburgh. New England delegates may leave home Saturday evening, in time to connect at the start. If you are willing to join the party please fill up and sign the attached blank, and return to me promptly, as we must know what to depend upon, as soon as possible."

The Stock Exchange Dispensing with "Tickers."

A great sensation was caused in Wall street on May 31, when at the close of business on the New York Stock Exchange it was announced that the Governing Committee had decided to dispense with the ticker service, the contracts with the Gold & Stock and Commercial Telegram companies having expired. The object of this step was to meet the recent decision of the courts that the quotations when handled by the ticker companies became public news, which must be given to all requiring them, without exception or discrimination. Taking the bull by the horns, the Stock Exchange decided to cut off the bucket shops by cutting off everybody, and by furnishing no quotations at all to the public. In Chicago the Board of Trade followed a similar course of action.

This action of the governing committee has been generally approved by the brokers, though it is naturally protested against by the proprietors of the bucket shops. At the Consolidated Exchange, a rival body of which the Stock Exchange has been jealous, there was much discussion of the matter, but the members there met the situation by making their own quotations. The Consolidated has its own ticker service, that of the Stock Quotation Company, and this is in active work.

In the interim, the Stock Exchange has returned to the old method known as "pushing the pad," which consists in sending out the latest quotations from the floor by means of slips from pads. This crude form of messenger service is supplemented by the telephone, which is of great assistance. It is stated that this week, regular quotation bulletins will be issued to members every 15 minutes, by means of which also, downtown brokers can advise their uptown customers over private wires.

Some kind of action may be looked for from the ticker companies thus cut off from the source of news and of revenue. Mr. Chandler, speaking for the Commercial Telegram Company, said last week that the tickers had been cut off without notice, and no action had yet been decided upon. He did not know whether any legal proceedings would be begun or not. He thought that the brokers would not be long satisfied with receiving quotations by messenger and telephone. Those brokers who were nearest the Stock Exchange would have too great an advantage over those who had offices further away. With the ticker system everybody received his news at the same time.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, June 3, 1889.

Mr. E. B. Stephens, manager of the Splitdorf Wire Company, having but lately taken that position with the company, died on May 26 of pneumonia, after four days' illness. He was buried on May 29 at Saratoga, his home.

Mr. Knight Neftel has opened new offices for the Daft Electric Company, at 13 South Fourth street, Philadelphia. Mr. Neftel is widely known in military and commercial circles as a member of the old firm of Neftel & Oothout, engineering contractors.

The Sawyer-Man Electric Company, 510 West 23d street, New York, on Monday, May 27, received, from all parts of the country, orders for 14,750 incandescent lamps. This is a sample day, showing the enormous growth of the business of that company, and it should be remembered that this is the dull season.

Mr. Horace Van Sands will shortly represent the well-known house of Holmes, Booth & Haydens, 25 Park Place, on the road, visiting all the principal cities. I have no doubt that he will be well received, and secure plenty of encouragement, both on the score of his personal qualifications and on the high quality of his goods.

The Price of Copper.—Wire manufacturers and others have continued to watch the fluctuations of the copper market pretty closely, and they were not at all depressed at seeing ingot copper drop to 12 cents per pound about May 18, since which time, I understand, the manufacturers have been overrun with orders, and have reduced their prices proportionately with the lower quotations in the market.

Mr. W. P. Wilkins, of 46 Marion street, is laying himself out for electrical manufacture, with a view to the production of special apparatus in any quantity. He has excellent facilities and skilled mechanics at his command, and his shops are equipped with the latest improved lathes, planers, presses, screw machines, drills, etc. I would recommend him to any who are looking out for a manufacturer to undertake the construction of new apparatus.

Mr. J. L. Lazelle, who was well known to the electrical fraternity up to a couple of years ago, under the firm name of J. L. Lazelle & Co., 108-110 Liberty street, in the manufacture of electrical apparatus of all kinds, has just returned to this city after a long absence, and says that he proposes to locate here, as it is his home, and that he proposes to join hands with some enterprising firm who are looking for a bright man in the manufacturing business, where his knowledge and skill would be appreciated.

Mr. L. Stieringer, Mr. P. H. Alexander and a party of friends have just returned from the mountainous wilds of North Carolina, where they have been enjoying the magnificent scenery and sampling the mountain dew that never paid excise. It is hard to say which they admired most. But they return to town vastly better for their enviable holiday. It is well known that Mr. Stieringer and Mr. Alexander hold extreme views on the subject of incandescent lighting, but as unlike poles always attract each other, these two gentlemen find the greatest pleasure in each other's society.

Mr. A. A. Knudson, the well known and energetic New Yorker who has been making things lively in the telephonic way in Nova Scotia and New Brunswick for the last two or three years, has now been appointed general superintendent of the electrical exhibition which is to be given at St. John, N. B., opening July 22, to celebrate the junction of the Canadian Pacific Railroad uniting St. John and Portland. A large number of electrical exhibits are already promised and there is no doubt that Mr. Knudson will be able to give the "blue noses" a pretty good idea of what electricity can do.

The Union Fire Alarm Company I found last week comfortably settled in their new quarters, 62 and 64 Cedar street, under the general management of Mr. Donnington. Their system is the invention throughout of Mr. Murray, who was well known as one of the most successful manufacturers during the early days of the telegraph, and whose brain power and energy are still as great as ever, enabling him to produce one of the most practical fire alarm systems now in vogue. The system is in active operation in various places, and the company are now filling a number of orders for complete outfits.

The Waste Oil Filter Company, of 322 Pearl street, are making two sizes of waste oil filters intended for use in electric light stations. The smaller will filter from three to five gallons of oil in 24 hours, and the larger from ten to twenty gallons. They are made of galvanized iron, nicely japanned, and are very strong and durable. There are several hundred in use, and among the places where they may be found are the Edison Works, Schenectady, the Edison station at Patterson, the station of the Salem, Mass., Electric Light Company, the United States station, Stanton street, etc.

The Fogg High-Speed Engine.—While passing 94 Liberty street, on Friday afternoon last, I noticed quite a little commotion, and when I stepped in to see what the matter was, I found out that the apparatus which was exciting so much interest was the Fogg high-speed engine, made with a disc, with four cylinders on its face. There are two piston rods connecting the four cylinders across the face of the disc, which revolves around the shaft. The power is transmitted by double cams, which drive the shaft. Mr. C. F. Fogg, the inventor, claims that he develops 75 h. p., running at 900 revolutions. The cylinders are 3 by 3½, and the whole machine takes up a space of about two by four feet.

The John Stephenson Company, Limited, report themselves as well equipped for the supply of cars adapted to all the electric motor systems. Their large stock of carefully-selected well-seasoned and skillfully-prepared lumber gives them unusual facility for prompt delivery, while maintaining the superiority of every phase of their work. Their standard is always kept to the peak, and their unvarying motto is "The Best." The new cars from the works recently put on the East Reading road are probably the most comfortable electric cars now in use. They have the new Stephenson truck, which takes all the machinery and appliances, and the body rests upon "super" rubber springs, thus completely insulating the body from all noise, jar or shocks, and giving greater ease and comfort to passengers.

The Peckham Street Car Wheel and Axle Company have located their works at Kingston, N. Y., and are equipping their shop with tools especially adapted for the manufacture of their motor wheels and axles. They have received orders during the last month from the following named parties: White Line Electric Railway Company, Dayton, Ohio; Asheville Electric Railway Company, Asheville, N.C.; Black Rock & Salisbury Beach Railroad Company, Newburyport, Mass.; Daft Electric Light Company Marion, N. J.; Bentley-Knight Electric Company, New York, N. Y.; Port Huron Electric Railway Company, Port Huron, Mich.; Brooklyn City Railroad, Brooklyn, N. Y.; Albany Railway Company, Albany, N. Y.; Newburyport Car Manufacturing Company,, Newburyport, Mass.; Union Depot Railroad Company, St. Louis, Mo.; Jamaica & Brooklyn Railroad Company, Brooklyn, N. Y., and others.

Mr. E. H. Johnson retires from the presidency of the Edison Company on the first of this week, and will now devote his energies actively to the affairs of the Sprague Company, of which he has also been the president and the animating spirit since its organization. There is no doubt that now that Mr. Johnson has relieved himself from the heavy cares and responsibilities of the Edison management, he will be able to push the Sprague Company to a higher pitch of prosperity and progressiveness than it has ever before reached. Everybody remembers the condition of affairs in the Edison Company when he took hold of it in 1885, and everybody knows, also, the shape in which he leaves it at the present time; and from this little episode in his striking career, if from no other incident, it would be easy to infer how great will be the impetus which he gives to the electric motor industry by his more active participation in it.

P. & B. Compound in the Subways.—Hundreds of thousands of feet of wire and cable have been put underground in New York City in the past few months, and it is a fact worthy of note that in every instance they were painted or covered with P. & B. electrical compound. In the specifications for these conductors this paint was called for. The reason for such a stipulation may be found in the experiments of the Bell Telephone Company of Philadelphia, who last year drew out all the wires from their conduits and found that the only one that was intact and in fit condition to put back was the cable made by the Standard Underground Company, and protected in this way. Mr. Wiley, the manager of the Standard Underground Company in this city, has, by the way, furnished most of the New York cables just spoken of. As I mentioned in my notes last week, the compound has also received the indorsement of the Marr Construction Company after its severe ordeal in the Hoosac Tunnel, where it was subjected to every form of direct and insidious attack. It seems to me that the various city officers through the country, and particularly the underwriters and other authorities, will do well to see to it that the use of such material as this compound is everywhere insisted upon.

The Splitdorf Insulating Wire Company, at their new quarters, 187-189 Cherry street, are busily engaged bringing out their new product for the market. The place that they occupy the third floor of the old Sailors' Exchange, and gives them a high ceiling, with light on all sides, so that their work, which requires great care and cleanliness, is carried on under very favorable conditions. Mr. Splitdorf remarked to me in conversation last week, while commenting on the death of Mr. Stephens, his manager, that the sad incident called to his mind the time when Morse first began his telegraphic work, and when so many of those who are now old timers were making their debut in the field of telegraphy. Mr. Splitdorf was acquainted with Prof. Morse, and well remembers his visit to Philadelphia to get his first instruments. Mr. Splitdorf says also that he made his first repeaters on the lines of those which are now in general use, the repeater in question being patented by Mr. J. C. Clark, who afterwards became a partner of his. In those days the apparatus was crude and the insulated wire that was on them was roughly made. To illustrate the advances in this respect, Mr. Splitdorf showed me some No. 26 wire which he has recently insulated and which could be placed in damp or wet places without suffering any leakage of current through it. Even in a couple of years, since the company took up the manufacture of Mr. Splitdorf's specialties, they have increased from a few machines up to nearly one hundred, involving many improvements in insulation and the methods of its production. The wire is insulated with silk and with Sea Island cotton fibre for magnets of all kinds, annunciators, house and electric light wire. They are now covering wire up to No. 38, and will shortly be able to cover it up to No. 45. The company hold a number of testimonials from leading concerns in New York and throughout the States for the beauty, finish and high insulating quality of their wire. They have a number of specialties, such as wire for electrical instruments, arc lamps and armatures. Their fire and water-proof wire for switchboards has been adopted by the Western Union Company. The wire is tinsel, lacquered, and the cotton fibre is woven over it, making a perfect insulator impervious to water. It is then covered with pure rubber, and over this is woven a thin layer of asbestos, which is again covered with silk or cotton, like all flexible cords. The armature wire, I may mention, is also insulated with asbestos and cotton.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, June 1, 1889.

Mr. Henry D. Stanley, of the Bridgeport Brass Company, is a visitor to the city this week.

Mr. Cyrus O. Baker, Jr., of the Baker Platinum Works' Newark, N. J., was in the city this week.

Mr. Samuel M. Hammill, Jr., of the Brush Electric Company of New Yark, was in town this week.

Mr. S. M. Barton, general manager of the Thomson-Houston Electric Company in Chicago, has been in this city for the past few days.

Lowell, Mass.—Mr. F. S. Stevens has been awarded the contract for the Willow Dale extension of the Lowell & Dracut road It is to be equipped with electricity and will be running by July.

Taxation of Telegraph Companies.—The bill which was intended to tax telegraph companies on the number of miles of wire which they had on poles has been referred to next General Court, and telegraph companies will have time to gather in their forces for another fight.

Mr. Frank Ridlon continues to carry on the good work of disposing of second-hand electrical apparatus in various forms. I do not know by what mysterious means he gets his customers, but I do know that he has sold this week a 650 light incandescent dynamo and a 30-light arc dynamo.

Mr. Henry D. Hall, of the Empire City Electric Company was a caller at this office this week. Mr. Hall is making a short business trip through the principal cities of the Eastern States, visiting generally all the electrical fraternity. He reports business very brisk in the various electrical supplies.

Mr. H. H. Johnson, the superintendent of the Hartford Electric Light Company, was a welcome visitor at this office this week. Mr. Johnson has been out of the active field of work for some time, owing to severe illness brought on by overwork on his new electric plant, and I am glad once more to see him on his feet and looking so well.

Salem and Peabody Elevated Railroad.—The people of these two towns will not be transported from one to the other electrically and in an "elevated" condition for some time (I mean no offense to the citizens of these cities). The bill which provided for an electrical elevated railroad has been referred to the next legislature, and presumably will not be heard of again at present.

New Thomson-Houston Roads.—The Thomson-Houston Company has recently closed the following new contracts: The Citizen's Electric Street Railway, Decatur, Ill., 4 cars, 5 miles; Redbank & Seabright Railway Company, Redbank, N. J., 3 cars, 5 miles; Richmond Street Railway Company, Richmond, Ind., 6 cars, 4 miles; Rose Park Street Railway Company, Spokane Falls, W. T., 6 cars, 7½ miles.

Malden, Mass.—The Malden Electric Light Company has petitioned the Board of Aldermen for permission to erect additional poles and wires for the purpose of preventing the disturbance to the telephone wires, of which the New England Telephone Company have been complaining for some time past. This is a concession on the part of the Electric Light Company which does them credit, and which shows the good feeling which should always exist between different electrical industries.

Overhead Wires and Poles.—While the work of destruction is so gaily going on in New York it is curious to note that the Aldermen in Boston have just granted permission to the Boston Electric Light Company to use all its already existing wires, and, further, to erect such new wires as may be necessary for the business. The Boston Electric Company has already these rights under a charter in the State of Maine, but as it is incorporated in the State of Massachusetts, it is necessary to have the change in the permit.

The White Rail.—The ingenious and novel rail invented by Mr. R. T. White, of 12 Pearl street, Boston, and illustrated at the time in THE ELECTRICAL WORLD, is pushing its way into deserved recognition. Mr. White has a number of sample sections of his chair and rail which he is sending out to companies applying for them. The rail is to be handled in Kansas City by Mr. Thomas Ashburner, Keith & Perry Building, and in St. Louis by Mr. Thos. C. White, of 413 Bank of Commerce Building—branch office of the Fulton Foundry.

Elevated Railroad.—Boston insists on having an elevated road, and Boston insists on having an *electric* elevated road. Such a decision is very apparent by the manner in which the promoters of the scheme are fighting for success. Not discouraged by the failure of the last bill, the petitioners have come to the front again, and this time with the strong re-inforcement of electricity behind them. The bill goes forward now to the House of Representatives as an Electric Railroad Bill, and there seems little doubt that it will be successful in the near future.

Gasoline Explosion in Van Ness House.—Another fatal accident resulting in the death of one man, draws attention forcibly to the extreme danger of using a fluid of such inflammable properties as gasoline for the purpose of illumination. With so many electric light companies ready and willing to furnish light, reliable and cheap, it seems incredible in this advanced age that a hotel in the heart of a city like Boston should be so far behind the times as to contain bottled up in its cellar a store of death and destruction in the shape of a tank of gasoline.

Wheeler Reflector Company.—On a recent visit to the factory of the Wheeler Reflector Company, I was very much interested to find that such a large factory could be kept busy in making a specialty of reflectors for electric lights. Mr. Wheeler tells me he makes reflectors as large as 84 inches diameter, and for church or hall use there is no doubt but that they are a valuable adjunct. This company is introducing also a metal reflector for factory use, which has a glossy enamel white inside, with a green painted back, which is very efficient, and, at the same time, cheap.

The Electric Gas Lighting Company.—During the week I looked in at the factory of this company, and was informed by Col. Burnham that they were doing a large business in importing the "Samson" battery from France, and that it was meeting with the greatest success. Col. Burnham has just issued a little pamphlet entitled "Some Important Correspondence Relative to the Comparative Merits of Different Open Circuit Batteries," which deserves attention at the hands of every one using such batteries, as the opinions given therein are from the pen of Prof. Dolbear, an undisputed authority on the subject.

Middleboro, Mass.—Gas companies are fast becoming aware that it is no use to try and combat electric light, but yet they ought not to wait until an electric light company has secured a franchise in the city before becoming active advocates of electric light themselves. The Middleboro Electric Light and Power Company claim they got a franchise for the lighting of the streets on Jan. 12, and they are now appealing from the decision of the Selectmen, who recently granted permission to the Middleboro Gas & Electric Company to erect poles and wires for the purpose of lighting the streets. It is an interesting dispute and the result is looked forward to with much interest.

Newton, Mass.—This city seems to be waking up to the fact that the days of employing horses for the purpose of street railroads are fast passing into history. While we all love the horse, and are not altogether averse to watching the merry gambols of a refractory mule, yet one is glad to see that electricity is likely to supplant these useful animals, and I congratulate the citizens of Newton on their determination to have the privilege for themselves and their guests of an electric railroad. At a recent meeting of the Aldermen the storage battery system seemed to be in favor, and these worthy gentlemen will soon have an opportunity of an experimental ride to enable them to judge intelligently of the advantakes of an electric road.

Spaulding & Buck.—The advent of hot weather is bringing "grist to the mill" in the shape of a number of contracts for Eddy motors to be supplied by Spaulding & Buck for fan work in restaurants. To those who cannot enjoy the cool refreshing Atlantic breeze with their mid-day meal, it is comforting to think that some attention is being paid to furnish them with an artificial means of cooling the fevered brow. This enterprising firm has also installed a 10 h. p. Eddy motor in the Bay State Electrotype Foundry in this city with good success. The Continental dynamo seems also to be meeting with general favor, and Temple House, on Washington street, has just been fitted with a 50-light plant, the Schaefer lamps being used.

McIntosh & Seymour Engine Company.—Among the most rapid of recent enlargements of business, allied to electrical interests, may be mentioned that of the McIntosh & Seymour Engine Company. Having scarcely completed an increase which more than doubled their works, they find themselves again called upon to add, to accommodate the increased call for their engines. The main machine shop is now 275 feet long by 40 wide, with auxiliary building, 145 feet by 35 feet, and running at present 22 hours of the 24, but even this plant is not sufficient to keep up with their orders, so that further increase is made necessary; and this also in view of the fact that all their castings are made at outside foundries, four of which are employed on the work. No better recommendation can be made for the engine than the favor with which it is received by the discriminating electrical people for whom the best is none too good.

The Thomson-Houston Electric Company reports the following sales: Binghamton, N. Y., 150 arc, 2,400 inc.; North Adams, Mass., 500 alt.; Petersburg, Va., 1,000 alt.; Yonkers, N. Y., 50 arc; Columbia, Tenn., 300 alt., 50 arc; Birmingham, Ala., 50 arc; Birmingham, Conn., 600 alt.; Americus, Ga., 50 arc, 500 inc.; Concord, N. H., 50 arc; Springfield, Mass., 90 arc; Anniston, Ala., 50 arc, 500 alt.; Lowell, Mass., 25 arc; Findlay, O., 50 arc; Weymouth, Mass., 90 arc, 1,200 inc.; Canastota, N. Y., 600 inc.; Middleboro, Mass., 30 arc, 600 inc.; Somerville, Mass., 50 arc; Weatherly, Pa., 35 arc; Shelbyville, Ind., 90 arc; Pittsfield, Mass., 500 inc.; Fitchburg, Mass., 75 arc, 500 alt.; Mahattan Company, New York, 150 arc. It also reports the following sales of apparatus for isolated plants: S. W. Brady, Toledo, Ohio, 12 arc, 600 inc.; Hart & Co., Cleveland, Ohio, 200 inc.; H. Ricker & Sons, South Portland, Me., 12 arc; H. W. Barrett, Louisville, Ky., 500 inc.; Cushing's Island Trans. Co., Portland, Me., 300 inc.; Henderson Woolen Mills, Henderson, Ky., 200 inc.; New York *Tribune*, New York, 400 inc.; Dolphin Manufacturing Co., Paterson, N. J., 500 inc. And the following: Fairbank Canning Co., Chicago, Ill., 70 arc, 1,000 inc.; Sheboygan Lumber Co., Sheboygan, Mich., 4 arc light plant; Pierce City, Mo., 30 arc, 200 inc.; Plattsmouth, Neb., 35 arc, 600 alt.; Janesville, Wis., 45 arc; Muskegon Chemical Fire Engine Co., Muskegon, Mich., 50 inc.; Illinois Steel Co., Joliet, Ill., 200 inc.

The Bennett Acoustic Telephone.—Every business man is now familiar with the electric telephone, as it is seen to-day under the Bell patents, but there are many who are not aware that for private use, such as connecting residences, for communication from residence to office, for speaking-tube use in stores, hotels, etc., there is on the market an instrument—the Bennett acoustic telephone—which fills all these demands for limited distances and which can be bought outright. The principle of the Bennett telephone depends solely upon the vibrations of a spring brass diaphragm, transmitted through a stranded iron wire tightly strung to a similar diaphragm at the other end of the line. The extreme simplicity of this instrument is seen by the description of the Champion telephone. In front there is an ordinary mouth-piece, serving to concentrate the waves of sound on to the brass diaphragm, which lies directly on the wooden board forming the base of the instrument. To modify the vibrations somewhat, a diaphragm of non-resonant material is laid in close proximity to the brass. The iron wire is then attached by means of a brass button, and the instrument is ready for use. The diaphragm of the telephone must be at right angles to the direction of the wire as it approaches the instrument, and where it is not convenient to bring the wire direct to the back of the telephone another modified form must be used. The Bennett telephone is provided with a curved tube from the mouth-piece to the diaphragm, which in this form may occupy a horizontal, vertical or oblique position to suit the direction of the outgoing wire, and which in the figure lies directly under the end of the receiving tube. In this system of telephony one of the most important factors of success is the method of supporting the vibrating wire and of turning corners. The "Gilliland" insulator used by the National Telephone Company is simply a ball of iron with a ring at each end, through which the tie wire passes. This insulator is not inserted between the vibrating wire and the bracket, but the tie wire merely passes around the insulator, being in contact both with the vibrating wire and the bracket, the insulator having the effect of preventing the vibrations from passing to the bracket and being lost. These telephones will work successfully over a distance of from two to three miles on straight lines, and where many angles are encountered about a half mile may be considered the maximum. The Bennett telephone is well covered by 15 patents, and has been successfully introduced in many cities in the East and West. A. C. S.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 City Trust Building, Philadelphia, Pa., June 1, 1889.

Vallee Bros. & Co., constructors and dealers in electrical supplies, are moving their offices and shops to No. 17 North Sixth street. Their increasing business necessitates this step.

Bedford, Pa.—The Thomson-Houston Electric Light Company, of this city, have just closed a contract to supply Bedford with 50 arc and 600 incandescent lights. The alternating system will be used.

The Camden & Atlantic Railroad Company, which operates the Atlantic City Electric Road, are preparing to erect a central station for furnishing power for their line. Plans and specifications are being drawn up and it is intended to make it a superior station in every respect. It is probable that some outside lighting will be done also.

Mr. C. H. Bragg, who has charge of the Westinghouse electric interests in this city, will place a 450-light plant in the new building recently erected by the Pennsylvania Company for Insuring Lives and Granting Annuities. It will be complete in every respect. Mr. Bragg has recently succeeded in getting the Girard Insurance Company to increase its plant from 1,000 to 1,600 incandescent lights.

Twelve Hundred Miles of Wire.—The American Long Distance Telephone Company are establishing a long distance service between Philadelphia and Baltimore, and Tobin & Killion, of No. 134 South Ninth street, this city, are putting up the wires. The line will be along the Philadelphia and Baltimore pike. The distance is over 100 miles, and as twelve lines are to be strung, over 1,200 miles of wire will be used in the construction. About thirteen miles of the line is already put up, and it is estimated that it will take six months to finish it.

The Murray Flint Glass Works, Trenton avenue, Culvert and Waterloo streets, this city, have been unusually busy for some time, their main specialties now being arc and incandescent shades of various shapes and colors, for all the different systems now in use. Their factory is one of the largest in the United States on this line of goods, and their trade extends beyond the United States and Canada. They have recently made some large shipments to Australia and also to the Paris Exposition. They have been very busy all this season and expect to work at their full capacity until the end of the blast, which terminates the latter part of June.

The Thackara Manufacturing Company are very busy with their present contracts for electroliers and combination fixtures, of which they make a specialty. They are now engaged in fitting up the School for Feeble Minded Children, at Elwyn, Pa., and will soon commence work on the Masonic Temple, where they have contracted to put in the fixtures and wire the entire building. They recently closed a contract to place the electrical fixtures in the new Park Theatre on Broad street, and will make a special job of it. Most of the globes will be tinted and arranged to produce the greatest artistic effect. As soon as their new store and factory on Chestnut street are completed the works will be removed from the present quarters, at Twelfth and Brown streets, so that all the departments can be in one building.

Good Business.—The Self-storage Electric Light and Power Company, at No. 733 Sansom street, report business good and prospects getting brighter every day. Their batteries have recently been tested for life, economy and efficiency, and, it is claimed, show surprising results. The Siemens Gas Lighting Company are using their batteries and motors in connection with their drilling machines with good satisfaction. The Philadelphia Blue Print Company are using the battery with the motor, and report that after eight days' work, during which 600 ampère hours had been taken from the battery, there was no apparent depreciation either in E. M. F. or current, while the cost of maintenance was nominal. The company are negotiating with some Canadian parties for the establishing of an agency in that territory, leaving the United States to be covered by different agencies or sub-companies.

The East Harrisburg (Pa.) Passenger Railway, which has been in operation upon the Sprague system for some eight or nine months, and which has already once ordered an additional number of cars, has recently sent in a second additional order to the Sprague Company for cars, this time two in number, to increase the equipment which it now has in operation. Nothing can more conclusively show the success which electrical railways are meeting throughout the country, and the confidence with which railway presidents regard their equipments, than the additional orders which the companies are announcing from all parts of the country. Indeed, there is, I understand, hardly an electric railway which has been in operation for any considerable time upon the Sprague system which has not ordered an additional number of cars. The railway at Richmond upon the Sprague system, also those at Wilmington, Wilkesbarre, St. Joseph, Hartford, Cleveland, Boston, Reading, Asheville, Tacoma, Atlantic City, as well as East Harrisburg and some others, have ordered additional equipments to supplement the ones originally ordered from the Sprague Company. The order in this instance was taken by Chadbourne, Hazleton & Co., the Sprague agents for this section.

A Complete Installation.—The New Park Theatre which is now being erected on Broad street, this city, by Manager Fleischman, of the Walnut street theatre, is to be lighted with 900 incandescent and 10 arc lights, besides having electric stage fittings. The arc machine will be of the Thomson-Houston make and two automatic Edison machines will supply current to the smaller lights. Power will be transmitted from two 40 h. p. Armington & Sims engines. All the mechanical and electrical apparatus will be located in a separate building just in the rear of the theatre, to ensure safety from fire or other causes. Walker & Keppler, Edison agents and contractors, have the contract. The stage regulator and switches, as well as all the cut outs in the building, are to be entirely fire and moisture proof and every light is to be under the control of a separate switch. Triple covered white core wire will be used. The contract specifies that every wire in the building must be so placed that it will be easily accessible.

All wires supplying lights on solid walls will be placed in a water and fire-proof non-metallic tube, placed under the plaster. This will be the first building in the city wired in this manner.

A large portion of the electric lights of the incandescent plant are to be used in connection with the decoration of the building. A number will be concealed back of ornamental glass and metal work, so as to produce an artistic effect. The arc lights will be used for outside illumination, exclusively. The plant is to be as complete a theatre plant as can be installed, and must be finished before Sept. 1.

E. F. C.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
41 Lakeside Building, Chicago, June 1, 1889.

Monte Vista, Col., is putting in an Edison plant of 500 lights.

Guthrie, Ok.—An electric light company is being formed at Guthrie.

Batesville, Ark.—The Batesville Electric Light Company contemplates the erection of an electric light plant in the near future.

Burlington, Wis.—The Village Board has entered into a contract with the Burlington Electric Light Company to have its streets lighted by electricity.

The Wisconsin Electric Company, of Milwaukee, has been incorporated, capital stock $10,000. Thos. R. Mercein, S. G. Schley, and H. F. Boggis are the incorporators.

The Missouri Electric Light and Power Company, of St. Louis, has received an order from Guthrie, Oklahoma, for a plant of 500 incandescent lights, to be put in as soon as possible.

Otay, Cal.—The Otay Watch Company will operate as owner the Westinghouse plant, which comprises two 250 light machines, two 35 h. p. Westinghouse engines and two 40 h. p. boilers.

Wauwatosa, Wis.—The new electric light plant in Wauwatosa, has been started up. For two months, since the burning of the old plant, the village has been in comparative darkness, and the event was the occasion of much rejoicing.

The Cream City Railroad, of Milwaukee, directors are contemplating the plan of putting electric motors on their cars, similar to those used on the Fourth avenue line in New York. It is to be thoroughly discussed at the next meeting of the directors.

New Birmingham, Tex., is basking and revelling in the beams of electric light, the Westinghouse plant of the New Birmingham Electric Light and Power and Street Railway Company having been started up by Messrs. M. D. Mather and W. J. Needles.

Alton, Ill., has a new contract for 40 electric lights at $90 per light. The Philadelphia schedule has been abolished, and the lights will be used every night, except when the Chairman of the Light Committee shall deem the moonlight sufficient, and so notifies the light company.

Fort Worth, Tex.—In connection with your recent illustrated article on the Westinghouse station at Fort Worth, it should be stated that the steam plant work was done by the Taylor Manufacturing Company, of Chambersburg, Pa., whose Beck automatic engines are operating in the station, and are doing so very satisfactorily.

The Milwaukee Board of Public Works will take into consideration at once the necessity of providing power to turn the city bridges more quickly than can be done by man power—the present way. The bridges, which it is proposed to turn by the new power, are six in number. Electric motor power is very favorably thought of.

Ishpeming, Mich.—The Common Council has granted a franchise to the incorporators of the Ishpeming & Negaunee Electric Railway, to build a street railway in this city. The line will be five

miles long, and will run between the two cities. It will be built at once, with branch lines on the principal streets of Ishpeming. Local capital will build the line.

The Pond Engineering Company havebeen settling up portions of their contracts with the Edison Company, of Kansas City, which it has finished. They have begun work on the engine foundation for the Union Railway, St. Joseph, Mo. This company also makes a specialty of furnishing complete pumping outfits, and closed a contract two days ago with the city of Baton Rouge, La., for a large sewerage pump. The boiler and pump for Madison, Neb., are now being set up.

The Standard Electrical Works, after months of experimenting in connection with Mr. Perry, a well-known chemist and electrician, have produced an amalgamated zinc that they feel sure will meet the wants of the trade,especially the telephone folks, with whom a zinc that produces a steady E. M. F. is very desirable. A thorough test of the zinc has been made for months with the very best results, and the Standard Works are now ready to put this zinc on the market and "stand behind it."

St. Louis Conduits.—A committee composed of the Board of Public Improvements of St. Louis, including the Mayor and several other officials, has been off on a junketing trip to Chicago and the Northwest, to investigate the matter of conduits for electric wires. The Dorsett Conduit Company was to have begun work before this, but it has not, for the reason that its plans were not approved. Since the committee returned they have been very quiet on the subject, but Col. Flad has been thinking a good deal, and it is probable that he may yet astonish us with one of his original propositions on the subject.

White Light Carbons.—The Electrical Supply Company have issued a special circular with regard to their white light carbons. The recent improvement in the manufacture of carbons since the introduction and widespread use of natural gas enables the company to produce a carbon having a firmer texture and freer from seams and impurities than, it is claimed, has ever been offered before. Particularly noticeable is the pure white light which the carbons yield. These carbons are made suitable for all systems, and are sent out in good shape, and are culled, the cracked and crooked ones being removed.

Storage Batteries in Wisconsin.—The first large storage battery plant ever put in operation in that city is now running the electric lights in the *Evening Wisconsin* building, at Milwaukee. It is the well known Detroit storage battery, manufactured under the Woodward patents, and was put in by the Wisconsin Storage Battery Company. The battery is composed of fifty-six twenty-three-plate cells, and when fully charged can stand for two weeks after being charged without showing any appreciable loss. It is charged by the engineer with the dynamo in the press-room, at convenient intervals during the day.

Denver, Col.—The Denver, Col., electric light companies have at last amalgamated under the title of The Denver Consolidated Electric Company. The new concern has a million do lars capital and operates the station at Twenty-first and Wewatta streets, where 2,200 horse power engines run nine dynamos of 65 2,000 candle power lamps each; two dynamos of 40 3,000 candle power each; four Edison municipal dynamos of 400 25 candle power lamps each, and eight We tinghouse alternating dynamos of 1,300 16 candle power lamps each. From this plant are at present operated 600 arc lamps, 1,000 street incandescent lamps, 12,000 inside incandescent lamps and eight towers, each 150 feet high, bearing six arc lamps, each of 3,000 candle power. There are 400 miles of overhead wire, 54 miles of underground cable, each cable carrying 29 wires, and 70 miles of alley mains, or a total of 524 miles of wire, sufficient to connect Denver and Omaha. To carry the overhead wires 760 poles are in use. The company employs 70 men, for whom the monthly pay roll is $6,000. The illumination last month would have been equal to 3.000,000 incandescent lamps for an hour.

Cobb Vulcanized Wire and Cable.—The Electrical Supply Company, of 171 Randolph street, have just issued, in very neat and compact pamphlet form, a price list of the Cobb vulcanized wires and cables, the manufacture of which was described not long ago in your columns. It will be remembered that in the Cobb process the pure rubber is vulcanized without being burned, so that the vulcanized insulation is bone-like without being brittle, and tough yet flexible, without being limp. It may be bent at any angle without cracking. The insulation is made in the form of long tubes. The wire is drawn into these lengths and made, by a special process, to lie loosely, yet snugly, in them, touching the insulation at comparatively few points. The result obtained is practically the same as though the wire were placed in absolutely dry air, but resting at just a few points upon an excellent insulator, between which and the wire no moisture can penetrate. Thus, owing to the smallness of the actual points of contact and their fewness, the insulation resistance, it is claimed, is the highest, and the inductive capacity the lowest, ever attained. The vulcanized insulation, moreover, is absolutely unaffected by acids, gas, vapors, etc., and hence has many recommendations, not only for underground work but for use in places where there is dampness of any kind. The pamphlet includes a number of remarkable reports from Professor Houston, Carl Hering, Prof. J. P. Barrett, and Mr. J. F. Mehren as to the nature and quality of the Cobb wire, and it is shown by all of them that the figures of insulation are unusually and remarkably high.

THE TELEGRAPH.

T. M. B. A.—Assessment No. 230 for June of $1 has been made to cover the death claims of J. A. Hard, W. M. Willis and E. L. Sheppard.

The Inter-state Telegraph Company has brought suit at Baltimore against the Baltimore & Ohio Telegraph Company for $50,000, on the ground of failure to carry out a certain traffic agreement, the result of such agreement being that the lines of the Inter-state Company running from Detroit, Mich., to Avilla, Ind., and Fostoria, Ill., costing about $40,000, were rendered worthless.

The Johnstown Disaster.—The Western Union Company has already succeeded in re-establishing some connections with the Pennsylvania district, devasted by the great storm and by the breaking of the South Fork Dam. The office in this city has been the scene of many painful incidents; hundreds of people trying in vain to reach their friends in Johnstown and to ascertain whether they are alive or among the slain thousands.

Cable Addresses.—A writer in the *Metropolis* says: "Superintendent Brown, of the Direct Cable Company, says that the only way trouble occurs about a registered cipher signature is when the signature is registered at the office of one cable company and the message comes over another line. The case of "not known" is thus explained. As it is sometimes inconvenient to send by any particular line from European offices, the safest method is to register at all the lines here. I have never tried the Commercial Cable, but, during years of experience with the Western Union and Direct Cable lines, I have never discovered a blunder nor even a doubtful word in my dispatches. Perhaps I am exceptionally fortunate."

In Cabling from Paris to New York on various occasions, I have found that the service is never so accurate as between London and New York. I wrote to the Paris director of the Commercial Company. He promised that every care should be taken. When I came to Paris I saw him, and I there learned the secret of the whole difficulty. The operators who send all cable messages from Paris to Havre are Frenchmen. "But," I said, "you have your own wires from Paris to Havre. Why don't you employ English or Americans?" "We cannot," was his answer; "we are not allowed to. You are aware that the telegraph is a government monopoly. They will not employ for any purpose any foreigner whomsoever," and he went on to say that even in their own office at Havre they had only been allowed to select their own operator after much pressure and difficulty. Between Paris and New York there is, of course, a very large cable business in English—very little in French. But every message which leaves Paris, whether by the Commercial or any other line, whether for America or England, or anywhere else, has to go by French hands. The French operator is supposed to know English, but the English which he knows is sometimes extremely peculiar.—*G. W. Smalley in New York Tribune.*

THE ELECTRIC LIGHT.

Griffin, Ga., is to be lit by a Brush plant.

Paris, Tenn., will soon have an electric light plant.

Eufaula, Ala.—The Westinghouse Electric Company is to put in a plant at Eufaula.

West Point, Miss.—The West Point Oil Company is to put in an electric light plant.

Navasota, Tex.—Mr. C. L. Budges will put in an incandescent electric light plant in the fall.

Vicksburg, Miss.—The Hill City Electric Light Company proposes to do incandescent lighting.

Fort Worth, Tex.—The Fort Worth Electric Light Company have established a motor circuit.

Winston, N. C.—Mr. B. F. Hanes proposes to put an electric light plant in his tobacco factory.

Columbia, Tenn.—The Columbia Electric Light Company will put in a Thomson-Houston plant.

El Paso, Tex.—The El Paso Gas and Electric Power Company has been formed with a capital stock of $300,000.

Conshohocken, Pa.—The Electric Light Company of Conshohocken, Pa., have purchased a controlling interest in the gas company.

Oak Park, Ill.—The Oak Park Water, Gas and Electric Light Company will put in an electric light plant, and has bought a lot for the station.

Dexter, Me.—The Dexter Illuminating and Power Company has now been organized with a capital stock of $9,900. C. B. Storry is president, and G. D. Hughes treasurer.

Elizabeth City, N. C.—A company is being formed to put in an electric light plant. It is said that the Van Depoele system will be adopted. C. Guirkin, Jr., is interested.

Thomson-Houston Lights in Paris.—The Thomson-Houston street lights in Paris were started on May 21 on the Rue Royale, and the regular service began next day.

Mobile, Ala.—The Alabama Fuel, Light and Supply Company has become the Alabama Electric Light and Power Company. Mr G. B. Clarke is president, and Mr. P. D. Barker, secretary.

Biddeford, Me.—The Biddeford & Saco, Me., Electric Light and Power Company have elected the following officers: president, George P. Wescott of Portland; clerk and treasurer, E. C. Hersey of Portland.

Lake Linden, Mich., and Red Jacket are to be lighted by the Thomson-Houston alternating incandescent system, on a circuit from five to six miles long. The Peninsula Electric Light and Power Company will do the work.

Knoxville, Tenn.—The University of Tennessee will run one or two small dynamos by their 25 h. p. Straight Line engine in the mechanical department, to supply light for use in connection with the instruction in physics, testing laboratory, etc.

A Threatened Indictment.—There is talk of indicting the United States Illuminating Company of this city for erecting lights without permits from the Board of Electrical Control. This awful threat involves a fine if the unfortunate officials are found guilty.

Butte City, Mont.—The Butte Electric Light Company are to increase their capital stock and to add a 750-light incandescent machine. Their present plant consists of 100 arcs of the Brush system, and is giving great satisfaction. Mr. J. A. Tupper is the general manager.

Brooklyn, N. Y.—In the suit of John Cleary against the Municipal Electric Light Company, to recover $50,000 as damages for injuries received by being thrown from an electric light pole at Broadway and Myrtle avenue, as he was putting a carbon in a light, a verdict awarding $6,600 was rendered May 29 in the Supreme Court.

Winchester, Va.—The local *Times* of May 8, just to hand has an enthusiastic account of the starting of the new Schuyler plant there. Cannons were fired, soldiery and firemen paraded, the public "jubilated," and the city went to bed very happy. The steam plant was installed by the Taylor Manufacturing Company, of Chambersburg, Pa.

The Union Electric Company, of Australia, Lim., has just been formed at Melbourne, Victoria, with a capital of £1,000,000, taking over the businesses of the Electric Light and Power Supply Company, of Australia. Lim., and the Southern Electric Company, Lim., of Melbourne. The company represents the Thomson-Houston Company and the Elwell-Parker Company, Lim.

Jamaica, West Indies.—Mr. Dean, of the Thomson-Houston International Electric Company, is now in Jamaica, at Kingston, engaged in forming a local company with a capital of $100,000. It is proposed to put in plant for street and house lighting, for the supply of small motors, and for the operation of the street railway. The scheme is very favorably thought of, and will doubtless be carried out on a more or less extensive scale. Gas in Kingston averages about $3 a thousand, and the street cars are run by the festive mule.

Canada.—The Montreal *Gazette* of May 23 says: At the Three Rivers council meeting on Tuesday evening, Messrs. Geo. McDougall and A. J. Corriveau, of the Royal Electric Company, appeared on behalf of a syndicate offering to supply electric light for the city's street lighting, the number of arc lights required and for two to three thousand incandescent lights for citizens' wants; also to furnish electric power for the running of the water-works and motive power for manufactures, etc. This would be supplied by electricity, transmitted from sixteen miles from the city where an immense water power capable of furnishing 10,000 to 15,000 horse-power, or more if necessary, exists on the St. Maurice River. The circuits, including the town circuits, would average thirty-six to forty miles. When this great scheme is carried out it will be a marvel in the world of electricity, and will reflect great credit on the city of Three Rivers and its promoters.

APPLICATIONS OF POWER.

Wilmington, Del.—Electricity will probably be used as the motive power for turning the draws of the Third and Eleventh streets bridges in Wilmington, Del.

West Troy, N. Y.—The Watervliet Turnpike Railway Company has been granted the privilege of running its cars through the village by electricity, using the overhead system.

Spartanburg, S. C.—Mr. A. H. Leftwich, of Greensboro, N. C., and his associates, are now looking into the various electric systems for their new road. They propose to build 10 miles, taking in from Glendale to Clifton.

Cleveland, O.—The South Side Railway have just received their new equipment of electric cars, all of the highest type of the John Stephenson Company's work, fitted up with motors and appliances by the Thomson-Houston Company.

Salt Lake City.—John Stephenson Company, Limited, are now preparing a lot of especially fine cars for the Salt Lake City Railway Company which are to be supplied with electric motors by th Sprague Company, making a first class plant.

PERSONALS.

Prof. Elihu Thomson sailed for Europe on May 29.

Mr. G. W. Davenport, and Mr. S. C. Peck, of the Thomson Houston Company, were in New York last week.

Mr. F. De Land, of the Sperry Company, has been a visitor to New York during the past week, and returned West on Saturday.

Mr. T. D. Lockwood, of the American Bell Telephone Company, sailed for Europe last week, on a vacation tour of two or three months.

Mr. A. B. Foote, of Cincinnati, is in the East. He is more than gratified at the reception of his book on the "Economic Value of Electric Light and Power."

Mr. W. H. Smith, the head of the Associated Press, had a narrow escape from the Johnstown flood, being a passenger on one of the trains which was wrecked and burned.

Mr. John T. Bluett, for 10 years connected with the Gold & Stock Telegraph Company, and well known on the floor of the Produce Exchange, died last week at Bloomfield, N. J.

Dr. Henry Wurtz, the well-known chemist, claims, through a letter in the *Engineering and Mining Journal*, to have invented the Williams Portelectric system in 1860, when he called it the "Electro-Magnetic Tachyphore," and submitted it to Prof. Joseph Henry. He says there are two British patents of Gaetano Bonelli and H. W. Cook on the same idea.

MISCELLANEOUS NOTES.

Georgia.—The Georgia Phonograph Company has been incorporated.

An Eighth Wonder.—So Mr. Edison has 8,000 square feet of space in the Paris Exposition solely for the display of the more important of his own works. Is there a parallel to this in all the annals of invention? This ex-newsboy is the eighth wonder of the world, and you are respectfully requested not to forget it.—*N. Y. Tribune.*

We Have Him On Our List.—The editors of THE ELECTRICAL WORLD consider that they violate no confidence in saying that they have excellent reason for believing that the machine which it is alleged is capable of flinging a man 15,000 feet up in the air, was invented by a long suffering electrician to meet the case of the man who persists in remarking that "Electricity is still in its infancy."

The Roxite Company has been formed under the laws of this State with offices at 69 Wall street, to make and sell Roxite in sulating material as a substitute for hard rubber in electrical work in insulation, etc. The company has W. Rossiter, J. W. Wilson, C. H. Skidmore, C. W. Morgan, R. H. Worthington as trustees, and a capital stock of $300,000. A sample of the material which we have seen closely resembles hard rubber. It is said to have many special advantages over that material.

BUSINESS NOTICES.

Chas. A. Schieren & Co., New York, are the patentees and sole manufacturers of the perforated electric leather belting. The perforations obviate air cushions; hence belts run slack with less strain on bearings, and without slip.

Woodhouse & Rawson, Lim.—At the general meeting of this company held in London on May 17, a dividend of 6 per cent. for the half year was declared, making 12 per cent. for the year, and carrying forward a balance of £13,440.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod, sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

To Investors.—A Chance for Electric Power.—A valuable water-power franchise suitable for developing electricity is offered for sale in a rich mining district, over 200 horse-power; can be sold at once in units varying from 5 to 50 h. p. within a radius of one mile from generating station. Address for particulars, Electric Mining, P. O. Box 2,382, Denver, Colo.

The Baker Common Sense Oil Filter.—These filters are rapidly coming into use in electric light stations both large and small. Among some recent installations are the Trinidad, Col., Electric Light Company; the Metropolitan Manufacturing Company, Middletown, Conn.; Evanston, Wyo., Electric Light Company; Burlington, Ia., Deaf and Dumb Institution.

Root Boilers.—The popularity of the Root safety water tube boiler, manufactured by Abendroth & Root Manufacturing Company, New York, as a successful safety boiler, is not confined to any section of the country, but extends from the Atlantic to the Pacific. The great safety assured by the use of this boiler for all steam generating purposes is an important consideration when the question of buying a boiler is mooted, not the least of its advantages being the heavy percentage of insurance saved. As an instance of its popularity in the West, we note from designs just furnished by J. M. Wood, Esq., architect, Chicago, that the California Hotel and Theatre, of San Francisco, one of the most notable and prominent structures of modern times on the Pacific Coast, is supplied with two of the Root boilers, 225 h. p., which will furnish power for the electric lights with which the edifice will be lighted throughout, as

well as for running the elevators. They will also be used for heating purposes. Messrs. Geo. H. Tay & Co., of San Francisco, were the contractors.

Indorsements of P. & B. Paint.—

THE MARR CONSTRUCTION COMPANY,
CITY HALL,
PHILADELPHIA, May 13, 1889.

H. M. Doubleday, Vice-President and General Manager, Marr Construction Company, Pittsburgh, Pa.:

DEAR SIR: My experience with "P. & B." electrical compound in the work at the Hoosac Tunnel installation has been in every way satisfactory. I have no hesitation in giving it the very highest recommendation in my power.

As an example of its protection against acids, etc., which attacked the lead cable, I would state that I had no further trouble with cables grounding after giving them a thorough coating of P. & B.

Also in regard to its insulating and waterproof properties, too much praise cannot be given it. During the summer of 1888 four joints were made in a cable with rubber tape, painted inside and out with P. & B. and thrown into water, which was very detrimental to the lead on the cable. This line was run on during a period of four months with 1,000 volts E. M. F., and never gave the slightest trouble, and when taken up to replace the temporary joints with permanent ones no action whatever was observable on the paint.

I take a great deal of pleasure in giving this recommendation, as the compound helped me out of many difficulties. Yours truly,

(Signed) EDWARD DAVIS.

THE MARR CONSTRUCTION COMPANY,
PITTSBURGH, Pa., May 14, 1889.

Standard Paint Company, 59 Maiden Lane, New York:

GENTLEMEN: We inclose letter of report from our Mr. Davis, who was in charge of the work of installation and proving the electric light plant of the Westinghouse Alternating System, built at Hoosac Tunnel for the Fitchburg Railroad Company, and can only say in addition that this office indorses the letter of Mr. Davis to its fullest extent. Yours truly, THE MARR CONSTRUCTION CO.

H. M. DOUBLEDAY, Vice-President and General Manager.

THE STANDARD PAINT CO.,
59 Maiden Lane, New York.

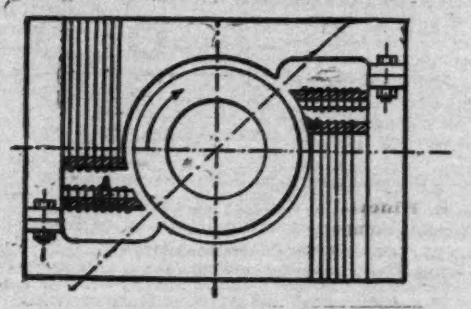
Jas. W. Queen & Co. have made special arrangements by which college professors, electricians and others intending to visit the great Paris Exposition can be saved much anxiety and trouble. The firm will furnish letters of introduction to their representatives in Paris, who will undertake to see to the forwarding to this country of apparatus purchased, and will also take care of books, photographs, etc., in the same manner. All such articles will be carefully packed and be kept at the Philadelphia store until called for. We would certainly advise our friends going abroad to avail themselves of these great facilities. They will be saved many a worry and no small amount of money.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED MAY 21, 1889.

403,515. Railway Signal; Thomas A. Casey, of New York, Assignor, by Mesne Assignments, to William Wallace and George A. Porter, both of Syracuse, N. Y. Application filed July 18, 1888. In combination with a normally closed circuit, circuit-breaker, electro-magnetic registering instrument and signal in said circuit, and said registering instrument actuated by electric impulses produced by intermittent closing of the circuit, a shunt normally open and forming then a more direct connection of the signal with the circuit, and closed by the first break of the circuit and before the registering mechanism is actuated.

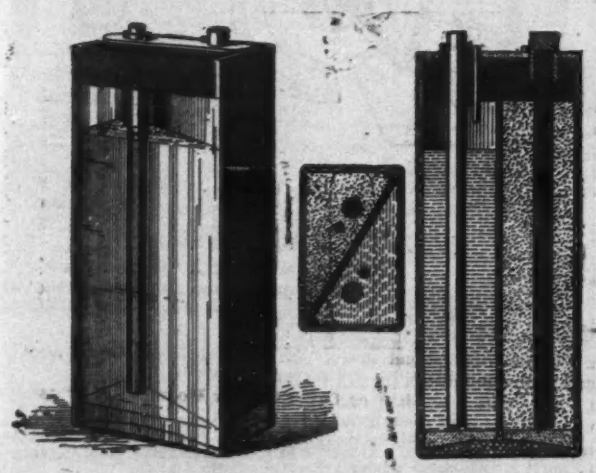
403,517. Electro-Magnet and Armature; Frederick W. Cole, of Newton, Mass., Assignor of one-half to Moses G. Crane, of same place. Application filed May 24, 1888. The invention is embodied in an electro-magnet of the usual horseshoe type, having its two poles side by side, and similarly shaped, combined with a pivoted armature and retractor therefor, said armature being pivoted on an axis parallel to the line joining the two poles, and the armature and polar extensions being so shaped that a portion of the armature moves laterally along or substantially parallel with a surface of the pole extension, so that the actual distance between the adjacent surface of the armature and pole-piece is small in amount and varies but slightly in different positions of the armature, although the mass of the armature as a whole approaches the poles of the magnet under the attractive influence thereof, and is removed from said pole under the action of the retractor when the attractive influence is removed.



403,886. DYNAMO-ELECTRIC MACHINE.

403,541. Electrical Converter; Hermann Lemp, of Lynn Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed Feb. 4. 1889. The invention consists, essentially, in the combination with a core or carrier of iron of circular, cyndrical, or endless form, upon which one set of the coils is wound, of a magnetic bridge piece of iron connecting the opposite sides of said core and wound with the other set of coils of the converter. Either set may be the primary. Current is passed through the primary in proper manner to form consequent poles at or near the terminals of the bridge, and in order to provide for regulation the coils are wound in a continuous series, and the series are connected at intervals to the plates of a commutator having two brushes, by which the current may be passed into the primary at any two opposite points, thereby permitting the position of the consequent poles with relation to the terminals of the bridge to be adjusted or varied, so as to regulate the strength of current set up in the secondary. See illustration.

403,547. Mechanical Telephone; William W. Nichols, of New York, N. Y., Assignor to the American Private Line Telephone Company, of same place. Application filed Oct. 1, 1887. The invention consists in combining with the diaphragm, diverging or radial flat plates of metal or other resonant material, held under constant tension by the line-wire, and in close contact with the diaphragm, and which serve to distribute the vibrations and relieve the diaphragm of the strain of the wire.



403,802. GALVANIC BATTERY.

403,549. Means for Operating Draw-Bridge Spans by Electricity; John M. Orford, of Bridgeport, Conn. Application filed March 2 1889. (For description see THE ELECTRICAL WORLD, April 20, 1889, p. 231.)

(1) 403,575. Machine for Separating Iron from Ores; Filed March 29, 1888. **(2) 403,576. Magnetic Separator.** Application filed August 23, 1888. Gurdon Conkling, Glens Falls, N. Y. (1) This invention relates to a machine which is intended principally for separating iron from the tailings of wet ore separators in an economical manner, but which also can be used for separating particles of iron from non-magnetic matter. (2) The combination, with a conveyor for supporting the mass to be treated, of a magnet, a disc revolving independent of the conveyor and magnet at a point between said conveyor and magnet, and means for revolving the disc.

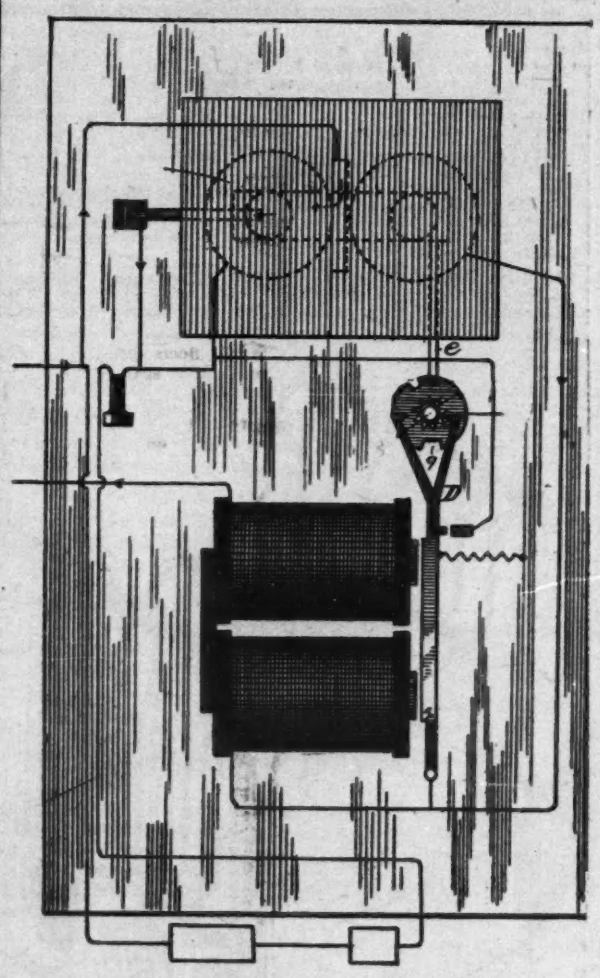
403,593. Secondary Battery; Augustus Jamieson, of Elizabeth, N. J. Application filed Sept. 27, 1888. The method of forming plumbic peroxide upon a surface of lead, which consists in first converting some of the lead into the plumbic sulphate, and then converting the sulphate into plumbic peroxide by treatment with hypochlorite of soda.

403,619. Switch Instrument for Railroad Signals; George C. Steenbergh, of Syracuse, N. Y. Application filed July 14, 1888. The combination, with a block of railway main track and siding connected, with said block, two electric circuits, circuit breakers at each end of the block connected with said circuits and actuated separately by the cars passing over the block of road, registering mechanism in the circuits actuated in opposite directions, respectively, by the circuit breakers at opposite ends of the blocks, and signals actuated by the registering mechanism, of two circuit breakers separate and independent of the circuit breakers at the ends of the block and connected, respectively, with two circuits and actuated separately, one by the movement of the switch rod in opening the switch of the siding and the other by the movement of the switch rod in closing said switch.

403,624. Magnetic Ore-Separator; William R. Thomas, of Catasauqua, Pa. Application filed March 30, 1889. An ore separator consisting of an endless belt, mounted on upper and lower pulleys, a supply chute having its lower open end located above the upper pulley and endless belt, a directing chute closed at the top and open at its lower opposite the upper pulley and endless belt, a magnet having its field located adjacent to and behind the vertically descending portion of the endless belt, a chute having its upper end located adjacent to the bottom of the field of the magnet and in front of the endless belt, with a passage between the chute and belt.

403,626. Telegraph Sounder; Frank L. Van Epps, of Hudson, Mich. Application filed Jan. 30, 1889. The combination, in a telegraph instrument, with armature lever and standard, having registered curved recesses on their lower and upper surfaces, respectively, of a rolling bearing piece in said recesses.

403,630. Dynamo-Electric Machine; Thomas L. Willson, of Brooklyn, N. Y., Assignor to John C. McGuire, of same place. Application filed Dec. 10, 1888. A dynamo armature consisting of an iron core mounted to rotate on an axis with a layer of independent and normally open circuited conducting bars insulated from each other extending longitudinally over the core and fastened thereto, so as to rotate therewith.



403,776. INDIVIDUAL CALL AND SWITCH.

403,671. Arc Lamps; Darius Houghton, of Skowhegan, Me. Application filed Dec. 15, 1888. In an arc lamp, feed-rollers mounted with their peripherical face in contact with the edge of carbon discs, whereby the surface speed of the carbon discs will always be the same until the discs are burned out.

403,691. Electrical Switch for Elevators; William E Nickerson of Cambridge, Mass. Application filed Feb. 25, 1889. In an electric switch device for elevator carriages, the combination of fixed electrodes arranged in offsets, with movable switch brushes in the elevator carriage adapted to be laterally adjusted for contact with said electrodes.

403,707. Process of Electric Soldering, Brazing and Welding; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Boston, Mass. Application filed Aug. 22, 1887. The method of electric welding, brazing or soldering, consisting in passing through one or both of the parts or pieces to be operated upon a heavy electric current in the general direction of the line or plane of the joint and of a volume sufficient to bring the piece or pieces to the requisite temperature. See illustration.

403,708. Method of Electric Welding and Brazing; Elihu Thomson, of Lynn, Mass. Application filed Oct. 19, 1888. The method of forming a welded or brazed joint, consisting in passing an electric current through the material from one side to the other of the joint, and then applying lateral pressure directly to the material at the part where the joint or weld is to be formed.

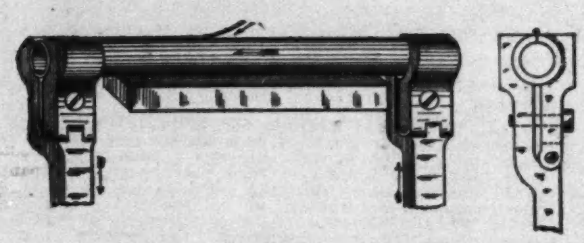
403,727. Insulator; Jacob C. Berrang, of Asbury Park, N. J. Application filed April 2, 1889. Insulator, composed of two insulating blocks and a plate having arms held between the blocks.

403,754. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa. Application filed April 8, 1889. A road bed for an electric railway in which one rail is higher than the other and the roadway between the rails is inclined, in combination with an electric conductor arranged at or near the highest rail.

403,776. Individual Call and Switch; Edwin Pope, of Quebec, Can. Application filed June 15, 1888. As an attachment for telephone boxes, the combination, with the polarized bell magnet and its armature, of a rod or pin attached to said armature, a notched wheel for governing the position of said rod or pin, an escapement for controlling said notched wheel, and an ordinary electro-magnet for operating said escapement. See illustration.

403,786. Electric Railway; Francis M. Speed, of San Francisco, Cal. Application filed Jan. 30, 1889. It consists of a conductor forming a roof over the insulation thereof, and a method and means of supporting and insulating said conductor.

(1) 403,800. Slotted Conduit for Electric Conductors. (2) 403,801. Electric Railway; Charles J. Van Depoele, of Lynn, Mass. Applications filed (1) June 6, 1888; (2) Feb. 15, 1889.



403,707. PROCESS OF ELECTRIC SOLDERING, BRAZING AND WELDING.

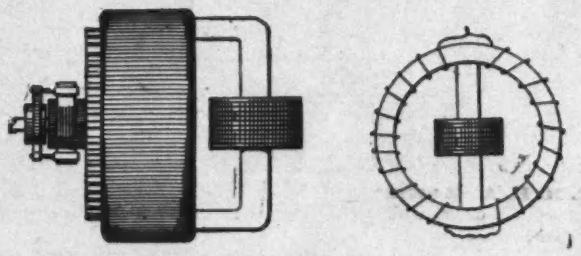
A metallic conduit for electric conductors, having a continuous interior lining of insulating material and a conductor and independent supports therefor within the conduit. (2) In a system of electric railways means for dividing the supply current at starting between a plurality of motors connected in multiple arc between the main conductors, comprising an additional resistance in circuit with each motor and means for gradually withdrawing the resistance as the speed of the motor increases.

403,802. Galvanic Battery; Joseph C. Vetter, of New York, N. Y. Application filed Aug. 18, 1888. A battery cell divided into two chambers by a partition of porous material in combination with a frame or plate supporting the positive and negative electrodes and a pair of ventilating tubes, one of said electrodes and one of said tubes extending down into each chamber. See illustration.

403,825. Underground Conduit for Electrical Conductors; Charles B. Cole, of Detroit, Mich., Assignor to the Cole Conduit Company, of same place. Application filed Oct. 11, 1888. An underground conduit for electric wires, consisting of a wooden box or casing saturated with an insulating material, separable wooden tubes, also thoroughly insulated, into which the wires may be inserted, insulating bridges adapted to keep the tubes in place, and a filling of plastic insulating compound adapted to exclude moisture.

403,836. Dynamo-Electric Machine; Alphonse Isidore Gravier, of Paris, France. Application filed Jan. 9, 1888. Patented in France, Jan. 17, 1887; in Belgium, April 18, 1887, and in England, April 19, 1887. In combination with the rotatory armature of a dynamo-electrical machine, field magnets provided on each side of said armature with two electro-magnetic cores of unequal magnetism and additional polar portions of less magnetism than either of said cores arranged after them in the direction of the armature's rotation, the cores of higher magnetism being in advance of the other cores and the said additional polar portions being magnetically connected with the magnetic frame of the machine intermediate between the said cores of less magnetism of one pole and the bases of the more highly magnetized cores of the succeeding pole.

403,868. Galvanic Battery; Don. J. Arnold, of Omaha, Neb. Assignor of one-half to Harlan B. Coryell, of same place. Application filed Jan. 25, 1889. A galvanic battery composed of a receiving and retaining jar and a solid filling consisting of litharge, chloride of zinc, muriate of ammonia, oxide of mercury, and a cement, as plaster of paris or hydraulic cement, a carbon or carbons, contact-posts, and a sealing cap of asphaltum or minera lpitch.



403,541. ELECTRICAL CONVERTER.

PATENTS DATED MAY 28, 1889.

403,905. Commutator; Harry H. Blades, of Detroit, Mich., Assignor to the Detroit Motor Company, of same place. Application filed Sept. 25, 1888. The commutator consisting of the head segment rods and an annular recess formed on the end of the head and rods, and in connection therewith a band of insulating material adapted to fit the said recess and hold the rods from displacement.

403,941. Automatic Cut-Out for Electric Lamps; Edward R. Knowles, of Brooklyn, N. Y., Assignor to the Mutual Electric Manufacturing Company, of New York. Application filed March 23, 1886. Renewed July 25, 1887. The invention consists in the combination of a fixed electro magnet of comparatively low resistance, with a movable electro-magnet of comparatively high resistance, the latter, when strongly excited, moving upward and completing the circuit through the fixed magnet.

403,944. Electric Gas Lighter; Joseph Hufty Lehman, of Philadelphia, Pa. Application filed Aug. 13, 1888. An electric gas-lighter provided with a magnet and electrodes operated by

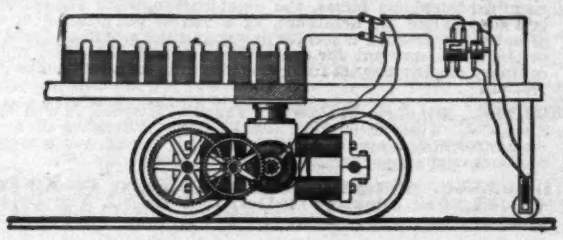
the magnet, having two branch circuits leading from the magnet, each including circuit-controlling devices, one located at the burner and the other at a distance from the burner.

403,955. Porous Cup for Batteries; Clarence B. Noble, of Cleveland, Ohio. Application filed Oct. 11, 1888. A porous cup, having an irregular surface internally, externally and on its bottom.

403,957. Secondary Battery; John B. Price, of Wollaston Heights, Mass., Assignor to the Electrical Accumulator Company, of New York. Application filed March 26, 1889. The invention consists in providing boards or strips of insulating material extending across the cell and about half its height. Near the upper edge and near its lower edge there are rows of equidistant perforations. Projections from each plate of an element are thrust through these perforations. The outer end of these ears or projections are perforated, and a rod is run through the entire series of projections to fasten them in position, at the same time providing for their easy and expeditious removal without the use of special tools. See illustration.

403,964. Arc Lamp; William L. Silvey, of Cincinnati, Ohio Application filed Nov. 12, 1887. In a focusing arc lamp the combination of a differential screw with a ratchet wheel capable of being turned in one direction only by the operation of a single electro-magnet whose coils are in a derived circuit, around the arc, the armature of the electro-magnet pivoted on the differential screw, and having a pawl attached to one end for turning the ratchet wheel, the other end having a spring mounted circuit breaker attached to it for the purpose of controlling the actions of the electro magnets.

403,969. Trolley for Electric Railways; Thomas Streat, of Richmond, Va., Assignor to himself and Edward Whitlock, of same place. Application filed Sept. 1, 1888. The invention consists in the combination, with the trolley, of revoluble guard



404,139. SYSTEM OF ELECTRICAL DISTRIBUTION.

arms, and in means for locking said arms against rotation in one direction.

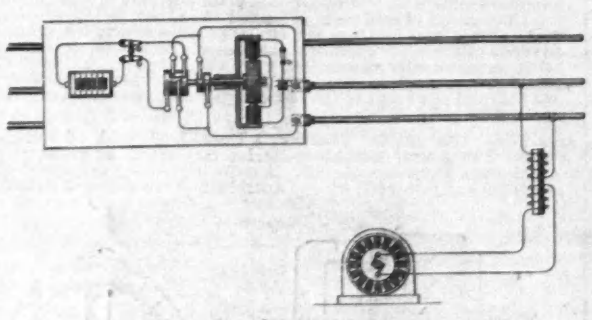
404,015. Electrical Switch for Elevators; William F. Nickerson, of Cambridge, Mass. Application filed Feb. 28, 1889. The invention consists in combining with a hand switch mechanism within the carriage of an elevator, electrically connected with the electrical devices by which the hoisting mechanism is controlled, fixed cam pieces outside and independent of the elevator carriage, arranged to operate the circuit-breaking devices within the car automatically, and thus cause the carriage to stop at the various landings when desired.

404,033. Push-Button; Herbert L. Currier, of Lynn, Mass., Assignor to himself and Albert H. Breed, of same place. Application filed July 12, 1888. By the use of this improvement the push button can be quickly attached to the wires, and the necessity of cutting the wires for this purpose entirely obviated.

(1) 404,067. Electric Motor; (2) 404,068. Dynamo; (3) Clamp for Electric Motors; Warren S. Belding, of Chicago, Ill., Assignor to the Belding Motor and Manufacturing Company, of same place. Applications filed (1) Nov. 15, 1887; (2) Feb. 2, 1888; (3) March 22, 1888. A commutator having a series of insulated plates, an annular recess, and wires in said recess and connecting said plates into groups; (2) The invention relates to dynamo electric machines and electric motors, composed of segmental sections interlocked at their meeting ends and built up of blanks cut out of sheet iron; (3) The combination, with an electric motor, of a rod extending through the lower portion of the frame of the motor, the ends of said rod projecting at each side of the frame, and a clamp, to engage the ends of said rod and a table.

404,112. Automatic Circuit Interrupter for Electric Circuits; Albert L. Reinmann and Philip Lange, of Pittsburgh, Pa., Assignors to the Westinghouse Electric Company, of same place. Application filed July 11, 1888. It has been found that carbon filaments may be treated with advantage by alternating electric currents, and it is desirable that after the treatment has proceeded to a certain point the circuit shou d be automatically interrupted, so that all the filaments after treatment shall have the same resistance. This invention is designed to provide a circuit controlling device which shall insure that the circuit leading to the filaments shall be interrupted and the treatment thereof terminate when the resistance of the filament has decreased to a certain predetermined point.

404,114. Electric Convertor Box; Albert Schmid, of Allegheny, Assignor to the Westinghouse Electric Company, of



404,139. SYSTEM OF ELECTRICAL DISTRIBUTION.

Pittsburgh, Penn. Application filed Dec. 26, 1888. A combined electric converter and converter box, consisting of the coils and core of the converter, the latter being formed of plates of soft iron, and a box having lugs between which the plates of the core are clamped.

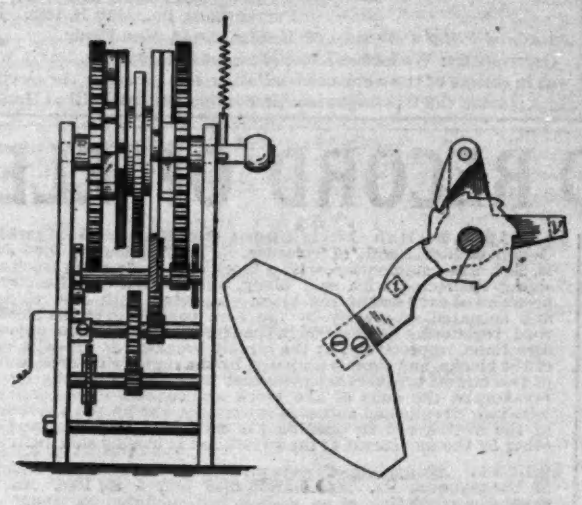
404,118. Apparatus for Treating Filaments; Frank Stuart Smith, of Pittsburg, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed March 12, 1888. The invention consists in employing, in connection with alternating electric currents for heating the filament, devices, whereby any required electromotive force may be readily obtained from a given source of current and the treatment caused to cease at the proper moment, and devices whereby the same source of currents may be utilized for conducting various different operations entirely independently of each other.

404,120. Regulating Self Exciting Alternate Current Electric Generators; William Stanley, Jr., of Great Barrington, Mass., Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Sept. 1, 1887. In general terms, the invention may be said to consist in supplying the field magnet coils with a rectified current derived from the secondary coil of an electric converter, the primary of which is included in a shunt around the work circuit or across from one terminal to the other of the generator. One coil of a differential wound inductive resistance is included in series with the primary coil of the converter, while the other coil of this resistance is included in series with the work circuit. The variations in resistance or counter electromotive force developed by reason of this inductive resistance governs the current through the primary of the converter, and then regulates the current delivered to the field magnet coils. See illustration.

404,139. System of Electrical Distribution; George Westinghouse, Jr., of Pittsburgh, Pa. Application filed Feb. 28, 1887. The invention consists, generally, in employing, in connection with an alternate-current electric generator, a circuit extending to a point in the vicinity of a railway preferably along the line of the track, and in transmitting currents of high potential over this circuit and transforming them into currents of lower potential at various points along the line of the track, and in straightening or rectifying the currents thusconverted, and in delivering the rectified currents to the motor. See illustrations.

404,149. Trolley for Electrical Railways; David Allen Ainslie, of Richmond, Va. Application filed Jan. 19, 1889. The combination of a supporting stand, a trolley wheel hanger, parallel arms pivoted at the stand and at their upper ends to the said hanger, and a contact wheel.

404,154. Lightning Arrester; Reginald Belfield, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Oct. 14, 1887. The invention con-



404,226. FIRE AND POLICE SIGNALING APPARATUS.

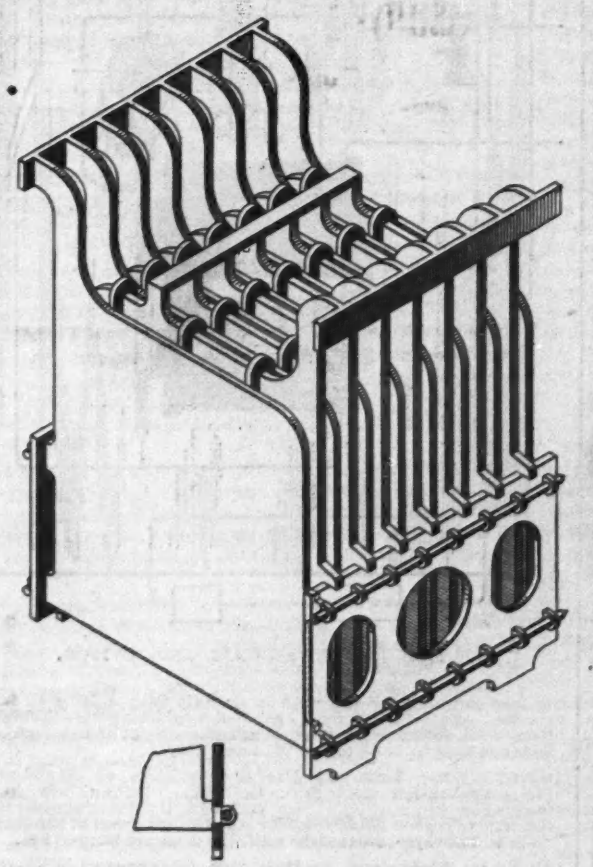
sists, in general terms, in constructing a lightning arrester for electric circuits with two pairs or sets of discharge points, one of said pairs being separable, together with an electro-magnet or other device for separating the latter pair, which magnet is included in a shunt circuit around the other pair.

404,165. Telegraph, John Burry, of New York, N. Y., Assignor of two-thirds to James E. Munson and Aloys Wirsching, both of same place. Application filed June 8, 1888. The combination, with a main circuit, of an auxiliary circuit having branches which include working magnets, switches arranged to direct the current over the auxiliary circuit through the different branches, switch magnets included in the auxiliary circuits and connected to operate the switches, and connections between the main circuit and the switch magnets, whereby different switch magnets are energized by different conditions of the current over the main circuit.

404,168. Secondary Battery; Henry F. De Bathe Cameron and Thomas Harris, of Detroit, Mich., Assignors of one third to Alfred Woodward, of same place. Application filed Feb. 20, 1888. A storage battery element consisting of a lead plate perforated with round holes for the reception of the salts of lead, said holes screw threaded, thereby affording firm engagement for said salts.

404,170. Electrical Signaling Apparatus; John Pressley Coleman, of Swissvale, Pa. Application filed April 2, 1888. Renewed May 4, 1889. In a signaling apparatus the combination of two or more signals, an actuating rod provided with locks which adapt it to be connected with each of said signals, electro-magnets controlling said lock, and electric circuits wherein the magnets are included.

404,221. Electrical Switch for Elevators; William E. Nickerson, of Cambridge, Mass. Application filed Feb. 23, 1889. It consists in placing in the well room of an elevator vertical



403,957. SECONDARY BATTERY.

metallic strips or wires, some continuous and others severed at each floor, which act as electrodes, and in placing in the elevator carriage a switch block, and push buttons adapted to act as switches for connecting the electrodes.

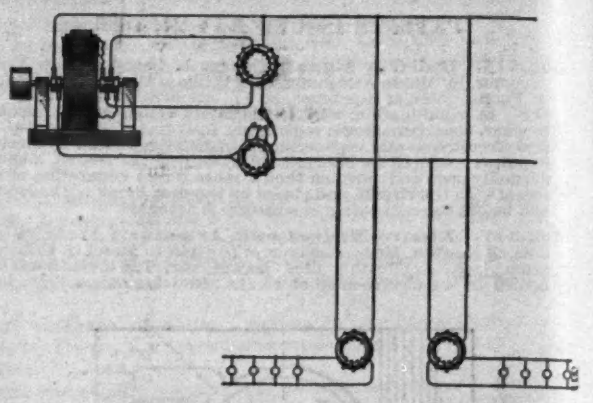
404,226. Fire and Police Signaling Apparatus; A. C. Robbins, of Brooklyn, N. Y. Application filed Dec. 2, 1887. In a fire or police alarm signal-box, the combination, with two signaling devices for sending definite signals and separate trains and gearing therefor, both loosely mounted on the same shaft of a weighted lever for operating each train, and a disc or segment fixed to the shaft between two levers, the said disc or segment being provided with a pair of catches to engage with the respective levers, whereby, by moving the shaft in the proper direction, each weight may be brought into operative connection with its train. See illustration.

(1) 404,244. Arc-Lamp; (2) 404,245. Electric Arc-Lamp; La Motte C. Atwood, of St. Louis, Miss., Assignor of three-fourths to Frederick Skrainka, Louis Skrainka, and Edward B. Roth, all of the same place. Applications filed (1) Jan. 23, 1889, (2) Feb. 17, 1888. In an electric arc-lamp, the combination of feed screws, arms connected to the screws and provided with clamps to hold the carbons, a stem on the clamp of the upper carbon passing through a perforation in the upper arm, a pivoted lever connected to the stem, an armature connected to the lever and a magnet supported by the upper arm.

404,306. Process of Electric Riveting; Elias E. Ries, of Baltimore, Md. Application filed March 5, 1889. Confines the current passing between the riveting tools forming the terminals of the circuit, to the rivet, so that the rivet shank within the holes, as well as the projecting ends, is raised to the requisite degree of incandescence and plasticity to insure the upsetting of the shank when the tools are applied to form the head or heads on the rivet, so that the rivet holes are completely filled by the shank.

404,310. Electric Meter; Robert Percy Sellon, of Lambeth, county of Surrey, England. Application filed March 6, 1889. Patented in England May 14, 1886. In an electric meter, the combination of a moving body, such as a pendulum, a counting mechanism, a pawl for actuating the same, a link for transmitting the motion of the pendulum or body to the pawl, adjusting mechanism, for varying the point of connection between the link and the pendulum or body, and thereby varying the stroke of the pawl, and a solenoid in the circuit whose current is to be measured, the core of the solenoid being connected with and actuating the adjusting devices.

404,324. Electro-Dynamic Motor; Charles J. Van Depoele, of Lynn, Mass. Application filed Feb. 28, 1889. In an electric



404,120. REGULATING SELF-EXCITING ALTERNATING GENERATORS.

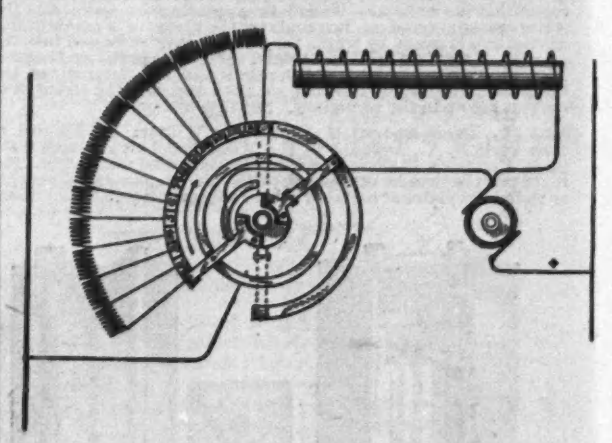
motor, the combination, with the armature thereof, of a long field magnet coil in series therewith, an adjustable resistance and means for placing any desired portion of the resistance either in series or in shunt relation to the coils of the field magnet. See illus.

404,325. Closed Slotted Conduit; Charles J. Van Depoele, of Lynn, Mass. Application filed March 21, 1889. A conduit for electric conductors comprising a slotted exterior casing, a conductor or conductors and supports therefor within the casing, flexible or yielding strips between the conductor supports and the casing, and an electric cushion or cushions between the flexible strips and the casing for holding the strips normally in close contact to close the slot.

(1) 404,332. Process of Separating Ores by Magnetism; (2) Magnetic Ore Separator; (3) Process of separating Ores; Clinton M. Ball, of Troy, N. Y., and Sheldon Norton, of West Troy, Assignors of one-third to Alexander T. Porter, of West Troy, N. Y. Applications filed (1) Sept. 26, 1888; (2) Oct. 5, 1888; (3) Jan. 14, 1889. (1) The invention consists in forcibly causing the tumbling or rolling of the particles of crushed ore through a compound magnetic field of alternating polarity, with or without the application of a current of air.

404,351. Electric Arc Lamp; John Robert Fox, of Fort Wayne, Ind. Application filed Aug. 18, 1888. In an arc lamp the combination with a central frame of regulating solenoids detachably secured thereto, hollow cores controlled by the solenoids, a positive carbon rod extending through the cores and a clutch controlled by the cores, said clutch engaging the carbon rod.

404,361. Electrical Apparatus for Controlling Elevators; Roland F. McFeely, of Pittsburgh, Pa., Assignor to the Electric Hydraulic Company, of same place. Application filed Aug. 17, 1888. The invention has for its object, first, to provide a device for operating the valve of an elevator by means of an elec-



404,324. ELECTRIC MOTOR.

tric current, which is so controlled from the elevator that the stopping of the car at the desired level is effected automatically by proper setting of the apparatus.

PATENTS EXPIRED MAY 28, 1889.

127,165. Improvements in Burglar-Alarm Apparatus for Portable Safes, etc.; Samuel J. Hoffman, of Mobile, Ala. The combination of a movable safe or other receptacle for the deposit of valuables, with an electric circuit and one or more alarm apparatuses, in such a manner that the said alarm or alarms will be sounded either by the opening or removal of the safe.

127,270. Improvement in Electrical Wood-Dividers; George Robinson, of New York, N. Y. The process of dividing wood by a platinum or other wire heated by electricity.

127,369. Improvement in Electro-Magnetic Motors; William H. Richardson, of Albany, N. Y., Assignor of one-half of his right to Henry C. Haskell, of same place. A revolving wheel carrying a series of sliding armatures.

PATENT EXPIRED JUNE 4, 1889.

127,483. Improvement in Electric Clocks; Vitalis Himmer, of New York, N. Y., Assignor to himself and Gustave Autenrieth, of same place. The invention consists in means of converting the vibrating motion of the pendulum into rotary motion of a train of gear wheels by which the hands of the clock are moved. In this is employed a friction wheel on the pawl shank, to be actuated by a pin that is swung by and with the pendulum.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.

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